With METALLURGICAL SUPPLEMENT.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 28, ESSEX ST., STRAND, LONDON, W.C. 2.

VOL. CLI.—No. 3937] LONDON: FRIDAY EVENING, JUNE 26, 1931 [PRICE {WITH SUPPLEMENTS} ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

Crown Agents for the COLONIES.

COLONIAL GOVERNMENT APPOINTMENTS.

APPLICATIONS from qualified candidates are INVITED for the following POST :—

M/2748.—ASSISTANT TOWN PLANNER REQUIRED by the GOVERNMENT of NORTHERN RHODESIA for a tour of 24 to 30 months' service, with possible extension. Salary £600 per annum, rising by annual increments of £30 to £840 per annum. Free quarters and passages. Liberal leave on full salary. Candidates must have had theoretical training and practical experience in the preparation of statutory municipal town planning schemes for new and existing areas, and a knowledge of survey and sub-divisional requirements in laying out land for building and other purposes. Preference will be given to applicants holding the Diploma of the Town Planning Institute of Great Britain or of such other Degree or Diploma as may be recognised as its equivalent.

Apply at once by letter, stating age, whether married or single, and full particulars of qualifications and experience, and mentioning this paper, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/2748. 7157

Heriot-Watt College, Edinburgh

DEPARTMENTS OF MECHANICAL ENGINEERING AND ELECTRICAL ENGINEERING.

MECHANICAL ENGINEERING :
PROFESSOR A. R. HORNE, O.B.E., B.Sc., M.I. Mech. E., A.M.I.C.E.
ELECTRICAL ENGINEERING :
PROFESSOR F. G. BAILY, M.A., M.I.E.E.
FULL-TIME DAY DIPLOMA COURSES leading to professional recognition.
CLASSES COMMENCE 12th OCTOBER.
Full particulars from the College.
J. CAMERON SMAIL, O.B.E., Principal. 7117

Northampton Polytechnic INSTITUTE.

ST. JOHN STREET, LONDON, E.C. 1.
FULL-TIME COURSES IN ENGINEERING are provided as follows :—
MECHANICAL,
CIVIL,
AERONAUTICAL,
ELECTRICAL, and
ELECTRICAL COMMUNICATION.

The Polytechnic is an Institution of the University of London, and courses are arranged to prepare matriculated students for the B.Sc. (Engineering) Degree of the University.

Entrance Examination, Wednesday and Thursday, 15th and 16th July, 1931.

For prospectus apply to
7132 THE PRINCIPAL.

County Borough of East Ham

EDUCATION COMMITTEE.

TECHNICAL COLLEGE EVENING CLASSES.

Principal : W. H. BARKER, B.Sc., F.C.S.

APPLICATIONS are INVITED for the POSTS of TEACHERS of (a) ENGINEERING DRAWING, and (b) MECHANICAL ENGINEERING. Preference will be given to candidates who have had experience in teaching these subjects.

Form of application (which should be returned immediately), together with conditions of appointment and scale of salaries, can be obtained from the undersigned on receipt of a stamped addressed foolscap envelope.

F. R. THOMPSON,
Secretary.

Education Office,
Town Hall, East Ham, E. 6.
June, 1931. 7149

Derbyshire Education Committee.

CHESTERFIELD TECHNICAL COLLEGE.

Principal : W. R. PARSONAGE, B.Sc., M.I. Mech. E.

A FULL-TIME LECTURER with good qualifications, to Take Charge of the Electrical Engineering Department, is REQUIRED from the beginning of the autumn term. Salary in accordance with the Burnham Award, together with an addition of £25 for post of special responsibility. Further particulars and a form of application may be obtained from and must be returned to the Principal, Technical College, Chesterfield, not later than July 11th, 1931.

P. G. FEEK,
Director of Education.
County Education Office, Derby. 7113

Imperial College of Science AND TECHNOLOGY.

CITY AND GUILDS (ENGINEERING) COLLEGE.

DEPARTMENT OF CIVIL ENGINEERING AND SURVEYING.

APPLICATIONS are INVITED for the APPOINTMENT of DEMONSTRATOR in CIVIL ENGINEERING and SURVEYING, City and Guilds (Engineering) College, commencing 1st September, 1931, or as soon as possible thereafter. Salary £250 per annum, with option of membership of Federated Superannuation System for Universities. Applicants should have practical experience in Surveying.

Applications should be made by 15th July, 1931, to the SECRETARY TO THE DELEGACY, City and Guilds (Engineering) College, Exhibition-road, South Kensington, S.W. 7, from whom further particulars may be obtained. 7137

PATENTS AND DESIGNS ACTS, 1907 TO 1928.

Notice is Hereby Given that

HUBERT SUTTON, ARTHUR JOHN SIDERY and BENJAMIN EVANS, all of Royal Aircraft Establishment, South Farnborough, Hampshire, SEEK LEAVE to AMEND the SPECIFICATION of LETTERS PATENT No. 345659, granted to them for an invention entitled "Improvements in or relating to Hardening Alloy Steels."

Particulars of the proposed Amendment were set forth in No. 2213 of the Illustrated Official Journal (Patents) published on 17th June, 1931.

Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of publication of the said Journal.

(Sgd.) W. S. JARRATT.
7150 Comptroller-General.

The Engineer

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PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for :—

550 STEEL COACHING TYRES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Wednesday, 24th June, 1931.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Tuesday, 7th July, 1931.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
7151 Secretary.

Borough of Richmond (Surrey).

WATERWORKS DEPARTMENT.

The Corporation invite TENDERS for the following :

CONTRACT No. 15.—The CONSTRUCTION of a SMALL PUMPING CHAMBER at their New Well at Ham.

CONTRACT No. 16.—The SUPPLY and ERECTION of TWO 4in. HORIZONTAL CENTRIFUGAL PUMPS, with ELECTRIC MOTORS of not less than 25 B.H.P., each pump capable of delivering 12,500 gallons per hour against a total head of 210ft.

CONTRACT No. 17.—The SUPPLY of approximately 93 TONS of CAST IRON PIPES (mostly 9in. dia.) and SPECIAL CASTINGS.

CONTRACT No. 18.—The LAYING and JOINTING of approximately 1257 YARDS of 9in. and 44 YARDS of 7in. MAINS.

Drawings may be seen and copies of the general conditions of contract, specifications, bills of quantities, and forms of Tenders for each of the above contracts may be obtained from Mr. Hugh P. Williamson, M.C., M. Inst. C.E., Water Engineer and Manager, Hotham House, Heron Court, Richmond, Surrey, on deposit of £2 2s. for each contract, which will be returned on receipt of a bona fide Tender and the return of all documents supplied.

Sealed Tenders, endorsed with the number of the Contract, should be delivered to the undersigned not later than 10 a.m. on Monday, the 13th day of July, 1931.

The Corporation do not bind themselves to accept the lowest or any Tender.

EDWIN M. NEAVE,
Town Clerk.

Town Hall, Richmond, Surrey,
June, 1931. 7153

PUBLIC NOTICES

Borough of Scarborough.

PROPOSED NEW HINDERWELL SCHOOLS.

The Town Council of Scarborough invite APPLICATIONS from Contractors willing to TENDER for the ERECTION of the above SCHOOL.

Bills of quantities are now in course of preparation, and applications should be made to Messrs. Pearson Shaw and Son, Quantity Surveyors, Long Acre, Bingham, Nottingham, not later than 8th July, accompanied by a deposit of £5 5s., which will be returned upon receipt of a bona fide Tender.

Plans and conditions of contract may be inspected at the offices of Messrs. H. Clifford Hollis and Arnott, Architects, 34, Paternoster-row, London, E.C. 4 ; Messrs. Pearson Shaw and Son, Bingham, Nottingham ; or the Education Offices, Scarborough.

The Council do not bind themselves to accept the lowest or any Tender.

H. V. WILLINGS,
7152 Director of Education.

Midlothian County Council.

RECONSTRUCTION OF BRAIDWOOD BRIDGE, NEAR TEMPLE.
CONTRACT FOR WORKS.

The County Council of Midlothian is prepared to receive TENDERS for TAKING DOWN BRAIDWOOD BRIDGE, over the River South Esk, near Temple, and for the CONSTRUCTION of a NEW BRIDGE there in Reinforced Concrete and for ALTERATIONS to the ROAD APPROACHES.

Under the Contract, 20 per cent. of the labour employed must be drawn from distressed areas and engaged through the Local Employment Exchange.

The drawings, specification and schedule of quantities may be seen at the office of Messrs. Blyth and Blyth, MM. Inst. C.E., Civil Engineers, 135, George-street, Edinburgh, on and after MONDAY, 22nd JUNE, 1931. Copies of the specification and duplicate copies of the schedule of quantities and form of Tender may be obtained from them on depositing £10. Cheques, made payable to the County Council, will be returned on receipt of a bona fide Tender.

Sealed Tenders, marked on the outside "Tender for Braidwood Bridge," must be lodged with the undersigned not later than first post on MONDAY, JULY 13th, 1931.

The Council do not bind themselves to accept the lowest or any Tender.

G. J. McGREGOR,
County Clerk.

County Buildings,
Edinburgh,
June 19th, 1931. 7136

PUBLIC NOTICES

The Manchester Steam Users' ASSOCIATION.

For the Prevention of Steam Boiler Explosions and for the Attainment of Economy in the Application of Steam, 20, QUAY-STREET, DEANSGATE, MANCHESTER.

Founded 1854 by SIR WILLIAM FAIRBAIRN.

Certificates of Safety issued under the Factory and Workshops Act, 1901. Compensation for Damages and Liabilities paid in case of Explosions. Engines and Boilers Inspected during construction. 6762

Metropolitan Water Board.

DISPOSAL OF SURPLUS PLANT.

The Metropolitan Water Board invite TENDERS for the PURCHASE and REMOVAL of the following SURPLUS PLANT in the Sunnyside Engine-house at their Hampton Works, Upper Sunbury-road, Hampton-on-Thames :—

4 Babcock and Wilcox Water-tube Boilers ;
1 Babcock and Wilcox Economiser ;
1 Fan and Fan Engine ;
All Steam and Blow-down Piping inside the Boiler-house ;
2 Compound Steam Engines driving Centrifugal Pumps, together with Condensers, Feed and Air Pumps, all Steam Piping and One Spare Crank Shaft.

The plant may be inspected at the above-mentioned works between the hours of 10 a.m. and 4 p.m. (Saturdays, 10 a.m. and 12 noon) on application to the Resident Engineer.

Forms of Tender, containing particulars of the plant and conditions of sale, may be obtained from the Chief Engineer by personal application at the offices of the Board (Room 155) or upon forwarding a stamped addressed sack envelope.

Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Surplus Plant," must be delivered to the offices of the Board (Room 122) not later than 11 a.m. on Friday, 17th July, 1931.

The Board do not bind themselves to accept the highest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
23rd June, 1931. 7146

The Chinese Government Purchasing Commission.

The Commission are prepared to receive TENDERS from British Manufacturers for—

About 9000 Tons of STEEL SLEEPERS and FASTENINGS.

Tender forms, general conditions and specifications can be obtained at the Offices of the Consulting Engineers :—

Messrs. Sandberg,
40, Grosvenor-gardens, London, S.W. 1.

A fee of £1, which is not returnable, will be charged for each set.

The Commission do not bind themselves to accept the lowest or any Tender, and reserve the right to divide and/or reduce the order.

Tenders on the official forms enclosed in sealed envelopes, marked "Tender for Steel Sleepers," and addressed to—

"THE CHAIRMAN,
Chinese Government Purchasing Commission,"
21, Tothill street,
Westminster, London, S.W. 1,

must be submitted before Noon on Tuesday, 7th July, 1931.

BY ORDER OF THE COMMISSION.
NPPS/IMH. 7139

Borough of Ilford and Barking TOWN U.D.C.

ILFORD AND BARKING JOINT SEWERAGE COMMITTEE.
INSPECTORS.

The above Authorities invite APPLICATIONS for the POSTS of THREE INSPECTORS on the Construction of Deep Tunnelling Work in compressed air in connection with the Joint Sewerage Scheme.

Only applicants who have had experience in this class of work will be considered, and the appointed applicants must be prepared to submit themselves to medical examination as required.

They must be prepared to take turns at the faces of shafts and headings with the working shifts day and night, and act under the instructions of the Authorities' Consulting Engineers, Messrs. W. H. Radford and Son.

Applicants should apply, stating age, experience and salary required, together with copies of three recent testimonials.

Applications, endorsed "Inspectors," and addressed to the undersigned, must be delivered at this office not later than the first post on 6th July, 1931.

BY ORDER of the Joint Committee of the above Authorities,
ADAM PARTINGTON,
Clerk to the Committee.

Town Hall, Ilford,
22nd June, 1931. 7141

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PUBLIC NOTICES

Egyptian Government.

TENDERS are called for by the Mechanical Department, Ministry of Public Works, for the SUPPLY and DELIVERY to Government Workshops, Boulaq, Cairo, of FOUR MARINE DIESEL ENGINES, GEARS, and ACCESSORIES for COAL BARGES, each 150 B.H.P.

Tenders should be submitted direct to the DIRECTOR-GENERAL, Mechanical and Electrical Department, Ministry of Public Works, Cairo, not later than Noon on the 1st September, 1931.

Copies of the necessary conditions of Tender, specifications and drawings, &c., can be obtained on application to the Chief Inspecting Engineer, Egyptian Government, 41, Tothill-street, S.W. 1, against remittance of £1 0s. 6d. per set, which sum is not returnable. Copies of these documents are also available for scrutiny at the above address. Firms on the Continent should apply to the Egyptian Consulate in their respective countries for the above mentioned documents. 7135

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

CIVIL ENGINEER, Young, Keen, Above Average, OFFERED OPPORTUNITY, out of office hours, on Detailed Preparation of a Large Hydro-electric Scheme with a number of Dams and Weirs.—Address, with particulars, P1245, The Engineer Office. P1245 A

DESIGNER WANTED, with Experience on Commercial Vehicles. Must have special experience in getting out designs for low cost of production. Give full particulars of training, experience, age, and salary required.
Address, P1246, The Engineer Office. P1246 A

FIRM of Oil Engine Builders in the South of England require

SHOP MANAGER.

Applicants should be between 25 and 35 years of age, keen and progressive.

Only men having a thorough knowledge of Machine Tools and methods of production will be considered.

Apply in first instance, giving full particulars and salary required, P1235, The Engineer Office. P1235 A

LARGE ENGINEERING FIRM REQUIRES Young METALLURGIST with works experience, for development of a process. Applicants should be university graduates, and state their metallurgical and engineering experience, age, salary expected, and supply copies of recent testimonials.—Address, 7154, The Engineer Office. 7154 A

MANAGER REQUIRED, to Control Constructional Steel Work Establishment. Must have expert knowledge in fabrication of materials in workshop, erection on site and production costs, also in negotiating contracts for all classes of constructional steel work.—Address, stating age, experience, salary required, and enclose copies of testimonials, 7134, The Engineer Office. 7134 A

TRAVELLER REQUIRED, with Connection Among Chemical Plant users, by old-established Firm of Engineers and Coppersmiths. State age, experience, salary required.—Address, P1263, The Engineer Office. P1263 A

WANTED, Capable DRAUGHTSMAN for Gravel Washing, Tarmacadam, Asphalt and Quarry Machinery. State experience, age, and salary required. —Address, 7143, The Engineer Office. 7143 A

FIRM of CONSTRUCTIONAL ENGINEERS in the North-East of England DESIRES to EMPLOY ONE or MORE JUNIOR ELECTRICAL DRAUGHTSMEN or ENGINEERS, to assist in the Preparation and Lay-out of Electrification (Power Distribution and Controls) of Iron and Steel Works.—Write, Box Z.R. 672, c/o Deacon's Advertising Offices, Fenchurch-avenue, London. 7118 A

FIRST-CLASS DRAUGHTSMAN, with Wide Experience in the Construction of Excavators and able to work on own initiative, REQUIRED by Crane Firm in the North of England.
Permanent position for suitable man.
Address, giving full particulars and salary required, 7160, The Engineer Office. 7160 A

SMART JUNIOR DRAUGHTSMAN WANTED, versatile, with some experience in Machine Tool Design, Jigs and Fixtures, &c. State age, experience, salary.—Address, P1254, The Engineer Office. P1254 A

SITUATIONS WANTED

ASSISTANT ENGINEER and DRAUGHTSMAN (27), special experience of process plant design, structures, and furnace work, and general adaptability, DESIRES progressive POSITION.—Address, P1252, The Engineer Office. P1252 B

CERTIFIED ENGINEER (28), with Practical refrigerating experience (including dry ice), 2 years in D.O., knowledge of oil engines, SEEKS progressive POSITION.—Address, P1243, The Engineer Office. P1243 B

COMPETENT ENGINEER (Age 39), Mechanical and structural, varied experience works and designing North England. Held positions (chief engineer, manager, structural engineer and sales; liberty end June. London and district only. Salary moderate.—Address, P1234, The Engineer Office. P1234 B

ENGINEER (36), Extensive Experience of Modern production methods for the manufacture of small accurate mechanisms, electrical and mechanical, used to control of all classes of labour, several years in managerial positions, DESIRES POST as Works Manager or Production Manager.—Address, P1248, The Engineer Office. P1248 B

ENGINEER, Scotchman, Disengaged, DESIRES APPOINTMENT. Wide CIVIL and MECHANICAL experience, home, Africa, Canada, India, America. Accustomed responsibility, control large staff, office, works field. Go anywhere. Excellent references. Keen, energetic, loyal worker.—Address, P1251, The Engineer Office. P1251 B

ENGINEER (M.I. Mech. E.), Resident London, DESIRES POSITION as REPRESENTATIVE, preferably in London area.—Address, P1262, The Engineer Office. P1262 B

Gears

See large advertisement next week.

The Power Plant Co. Ltd.

WEST DRAYTON · MIDDLESEX

DIRECTORS AND INVESTORS

OF

ENGINEERING & MANUFACTURING CONCERNS

are aware that the Incomes derived from their investments have of recent years been so seriously reduced (in many instances become non-existent) and the **Capital Values** so drastically depreciated that Shareholders are more than ever critical of the actions of those responsible for the conduct of the businesses affected.

* * * * *

The duties of **Directors, Secretaries** and **Accountants** were never more onerous than now, and in their own interests, as well as the interests of those they serve, it becomes imperative for them to adopt every means to create and retain the confidence of their shareholders.

* * * * *

The day has definitely passed when loosely drawn up **Balance Sheets** will suffice.

* * * * *

Experience has taught the Investor how little reliance can be placed upon the **Value** of the Company's **Premises, Plant** and **Equipment** appearing in the **Balance Sheet "At Cost,"** or **"At Cost Less Depreciation."**

* * * * *

Such entries are meaningless—highly prejudicial—and may bear no relation whatever to **Present Values,** as everything depends upon the **Period** when the **"Cost"** was incurred.

* * * * *

The Company's Auditors do not (and cannot) certify the value of these assets, which calls for Expert Knowledge and Technical Experience.

* * * * *

With the ever-changing values that are taking place not only does Prudence Suggest but Necessity Demands that these values be **Periodically Adjusted by Competent and Unbiassed Experts,** whose Certification, in addition to relieving the Directors and Accountants of unnecessary and undesirable responsibility, creates among the Company's Investors that Feeling of Satisfaction and Confidence so essential.

* * * * *

The more closely this question of Periodical and Independent Valuations is studied the more must one become convinced of the need of their adoption.

* * * * *

A Full and Detailed Valuation is by no means necessary, as something less elaborate (at a Materially Reduced Cost) will satisfactorily answer every reasonable requirement.

* * * * *

May we submit our proposals? They have been acted upon by hundreds of our clients with Beneficial Results and will, without doubt, prove helpful to you.

* * * * *

For Over 80 Years we have specialised in this work, and the Cumulative Experience we have gained will be gladly placed at your disposal without obligation.

WHEATLEY KIRK, PRICE & Co.

(ESTB. 1850)

SPECIALISTS IN VALUATIONS OF

ENGINEERING & INDUSTRIAL WORKS & PLANT,

46, WATLING STREET, LONDON, E.C. 4.

SITUATIONS WANTED (continued)

GOVT. ENGINEER (29), Public School. With Colonial Govt. Over five years carrying out variety heavy const. works and maint. steam and diesel stations, etc. etc., as Supt. Well recommended. OPEN TO OFFER suitable EMPLOYMENT abroad from established firm. Details on request.
Address, P1049, The Engineer Office. P1049 B

MECHANICAL and STRUCTURAL DESIGNING ENGINEER, 3 years' marine, 3½ years' oil refinery, 2½ years' general experience, DESIRES POSITION, home or abroad.—Address, P1178, The Engineer Office. P1178 B

MECH. CONSTRUCTIONAL and RAILWAY ENGINEER SEEKS POST, design, works, commercial, positions held, good organiser; home or abroad; age 44, speaks Spanish.—Address, P1259, The Engineer Office. P1259 B

SOUTH AMERICA.—To British Manufacturers. The Prince of Wales has given the nation a splendid lead. Why not follow it up and send me out there? I am an expert commercial executive (45), speaking Spanish, English, French and German, and have long experience and good connections in Spanish-speaking countries. Enterprising policy pays.—Address, P1206, The Engineer Office. P1206 B

WORKS MANAGER, Disengaged, Shortly SEEKS APPOINTMENT. Good organiser, splendid record; wide experience with largest firms, England and United States.—Address, P1215, The Engineer Office. P1215 B

LOCO. ENGINEER DRAUGHTSMAN, A.M.I.L.E., DESIRES POST, any capacity, at home or abroad; 3 years shops, 5 years D.O., tech. coll. certificate, National Diploma, fluent Spanish and French, wide experience; 4 years with engineering firm in Spain. Good refs.—Address, P1210, The Engineer Office. P1210 B

POSITION REQUIRED, Age 39, Past Experience foreman, ship and boiler repairs in England; 5 years locomotive boiler inspector in two main roads in U.S.A.
Foreman in structural steel, steel jails and general steel department.
Superintendent of locomotive syphon shop, blacksmith shop, carburising and hardening room in U.S.A.
Capable of handling any number of men. Please state salary.
Address, P1236, The Engineer Office. P1236 B

TO-DAY. Business Demands a Well-planned Sales policy. An ENGINEER and SURVEYOR, who has made a study of engineering markets over an extensive area of the British Isles, OFFERS his SERVICES to a company that can put his technical and commercial knowledge into the building up of bigger business.—Further particulars address, P1247, The Engineer Office. P1247 B

YOUNG ENGINEER (25) DESIRES POST; Eight years' practical and technical experience, thorough knowledge of Diesel engines.—Address, P1257, The Engineer Office. P1257 B

DRAUGHTSMAN, Experienced Elevators, Conveyors, structural steel work, aerial ropeways, electric telpherage, surveying and outdoor erection, complete plant lay-out; can take complete charge. First-class references.—Address, P1259, The Engineer Office. P1259 B

DRAUGHTSMAN (29), London; 3 Years' Tech. College, 5 years shops, 8 years D.O.; centl. and recips. pumps, gears, and general exp.; excellent refs.—Address, P1255, The Engineer Office. P1255 B

DRAUGHTSMAN (29) REQUIRES POSITION. Three Years shops, 9 years' D.O. experience, design and detail work, structural steel, plant lay-out and general engineering experience; good refs.—Address, P1256, The Engineer Office. P1256 B

FOREMAN MECHANIC, Wide Experience Textile and automatic machines, erecting and maintenance, DESIRES SITUATION, England or abroad. Speaks Swedish, Norwegian and German.—Address, P1240, The Engineer Office. P1240 B

FOUNDRY FOREMAN SEEKS POST; Experienced turbine Diesel-Fullagar oil engines, general jobbing, &c., loam, green and dry; excellent references; age 39.—Address, P1258, The Engineer Office. P1258 B

FOUNDRY FOREMAN (46), 16 Years in Entire charge, thorough practical knowledge all branches foundry work, hydraulic and general engineering, malleable cast iron and brass. Excel. ref.—Address, P1175, The Engineer Office. P1175 B

PARTNERSHIPS

EXCELLENT OPENING for a Good Practical ENGINEER with £3000 to join old-established progressive Engineering Firm. State age, experience.—Address, P1249, The Engineer Office. P1249 C

IN North Midlands a PARTNERSHIP POST WANTED in small Electrical and General Engineering Workshop. Invest £200.—Apply, T. ROPER and CO., Bromsgrove. P1241 C

£500 to £1000 INVESTMENT, View Partnership, GENTLEMAN'S SON WANTED as London Representative; references required.—Address, P1229, The Engineer Office. P1229 C

AGENCIES

WANTED, OFFICE ACCOMMODATION.—Engineer, having good agencies, wishes meet another with offices in Westminster having spare accommodation, idea reduce overhead; connection municipal and public works a recommendation.—Address, P1261, The Engineer Office. P1261 D

ENGINEERS, Hants Area, Connection with Engineers, architects and transport users, are PREPARED to REPRESENT sound Manufacturers of Steel Work, Tubular Goods and Castings.—Address, P1260, The Engineer Office. P1260 D

PROGRESSIVE AGENT MERCHANTS REQUIRED in each town in Great Britain.—Please communicate direct to THE LONDON VALVE COMPANY, Ltd., Gt. Bridge, Staffs. 7145 D

For continuation of Small Advertisements see page 4.

LOCOMOTIVE . MARINE . STATIONARY

"M.L.S."

SUPERHEATERS

To suit all requirements.
Specialists in Design and Manufacture

The SUPERHEATER COMPANY LIMITED

BUSH HOUSE, ALDWYCH, W.C. 2.

A Seven-Day Journal

Engineers' Wages.

NEW conditions of employment have been agreed upon by the federated engineering employers and the unions. After the negotiations had been resumed last Saturday a provisional agreement was reached. It was put before the unions by their representatives on Tuesday and accepted by a large majority. The new conditions are a compromise between those under which the men originally worked and those asked for by the employers, and will come into force, providing no difficulty occurs at any later stage, early next month. The changed conditions are noted under four heads, the chief items being given below. Overtime on dayshift is to be paid at the rate of time and a-quarter for the first two hours and thereafter at time and a-half, while a workman going home between midnight and 2 a.m. shall be paid time and a-half for hours worked after midnight and plain time for the period between the time he went home and 6 a.m. Nightshift is to be paid at the rate of time and one-sixth, while night overtime is to be paid at the same rates as those for the dayshift. In double dayshift and/or three-shift systems, the first shift is to consist of 43 hours' work, for which 45 hours shall be paid; the second, of 37½ hours' work, shall be paid as 45 hours; and the third, also of 37½ hours' duration, is to be paid as 47 hours, while each full shift will count as a full week for the purposes of war and special bonuses. As regards systems of payment by results, conditions have been agreed upon as to the alteration of and fixing of rates. Piecework prices, bonuses, or basis times are now to be such that an average workman can earn 25 per cent. over time rates, and rates at present fixed on the basis of 33⅓ per cent. will be lowered 6⅓ per cent., while those at present fixed on a higher basis of remuneration will suffer a reduction in the proportion of 33⅓ to 25.

A New Atlantic Record.

THE new Canadian Pacific liner "Empress of Britain," the machinery of which was fully described in our issues of May 8th, 15th, 22nd and 29th, set up a challenge for the supremacy of the Atlantic by passing Father Point, Quebec, at 3 a.m. on Monday morning, June 22nd. She left Cherbourg at 8 p.m. on Wednesday evening last week, and allowing a difference in time of 5 hours, her total steaming time between Cherbourg and Father Point was 4 days and 12 hours. On this particular voyage the liner took the northern route through the Straits of Belle Isle. The new record set up not only beats the existing Canadian record, but the vessel's time is shorter than the voyage of the North German Lloyd liner "Europa," which, on her maiden trip from Bremerhaven to New York on March 25th, 1930, set up a new record by making the voyage between Cherbourg and the Ambrose Channel Light Vessel at the entrance to New York Harbour, in 4 days 17 hours and 26 minutes at an average speed of 27·91 knots. At Father Point, which is about a 7-hours' run from Quebec City, the Canadian pilot, Customs officers and other officials, are taken aboard the liner, and it marks the terminal point which is used for calculating the speed of ships on the Canadian route corresponding to the Ambrose Channel Light Vessel on the New York route.

Glasgow's Water Supply.

THE annual inspection of Glasgow Corporation waterworks took place at the end of last week, and was attended by the Lord Provost, Sir Thomas Kelly, and about eighty members of the Corporation, including officials and guests. The event was of more than usual interest, since Loch Katrine is now at its top water level. The loch has risen more than 3ft. during the last six weeks, and the level of water is the highest since the Christmas of 1929, giving a reserve supply to the City of Glasgow of six and a-half months. The inspection of the works was begun at Milngavie, where the straining screens for the Loch Katrine and Loch Arklet supplies were seen. At Blanefield, the third 48in. pipe line across the Blane Valley, which is being laid in order to augment the discharge through the second tunnel into the Craigmaddie reservoirs, was inspected. The laying of a similar pipe line in the Endrick Valley is also contemplated, and when the whole scheme is completed at an estimated cost of £60,000, the discharge capacity of the tunnel will be 52 million gallons of water per day. The party also inspected the Kelty section of the works, while the Loch Katrine control station at Royal Cottage, which is now reached by a new path from Stronachlacher, was also visited. Mr. George Hinshilwood, the manager of the Water Department, who accompanied the party, gave some interesting figures concerning Glasgow's water supply. The waterworks now provide 56 gallons of water per head per day for each member of the community, of which amount it is estimated that 36 gallons are for domestic use, and 20 gallons for industrial services. Although the residential areas of the city have greatly increased within the last ten years, there has been no corresponding increase in the total demand, largely owing to a falling off in the trade supply following industrial depression. Whilst Loch Katrine now holds six and a-half months' reserve supply, it has been calculated that if only the waste within the supply area could be controlled, at least 2,000,000 more gallons per day would be made available for reserve.

A New Physics Building at the N.P.L.

LAST Tuesday, June 23rd, the new physics building at the National Physical Laboratory at Teddington, was officially opened by Sir F. Gowland Hopkins, President of the Royal Society and Chairman of the General Board of the Laboratory. In 1921 and 1922 the Executive Committee came to the conclusion that the space then devoted to Physics was inadequate, and in the preparation of a scheme of new buildings, one for Physics was placed first on the list. Plans were got out in 1924, and a design was prepared by Mr. F. A. Llewellyn. The proposed building had a frontage of 295ft., with wings 135ft. in length. At the back there was a single-storey, top-lighted area for furnace rooms, workshops, &c. Approval was obtained in 1928 for the erection of the central part of the building with a frontage of 180ft.; construction was begun in January, 1929. The completed section of the building is of three storeys, with a central tower. So that rearrangements may be made if the necessity arises the dividing walls between the rooms are not structural. All the service mains, electricity, gas, water, &c., are accommodated in ducts situated above the corridors, so that ready fittings to any room can be provided. No fixed benches are installed in the rooms and the usual sinks are supplemented by sinks let into the floors. That part of the building aready completed houses the Heat and General Physics section and some of the Radiology and Sound sections. It is hoped that during the next few years sanction will be obtained for the erection of the wings, so that the remainder of the Radiology section and the Temperature Standardisation work can be accommodated there. The quadrangle will be completed by the Acoustics building, the erection of a section of which has recently been approved. The opening of the new building preceded the annual inspection by the General Board, which was attended by a larger number of visitors than usual, and was favoured by admirable weather. The new high-pressure wind tunnel, which is almost ready for use, created considerable interest. A full description of this tunnel appeared in our issues of April 17th and 24th, 1931.

The Humber Bridge.

IN a series of Journal notes beginning in our issue of September 5th last year we recorded stages in the controversy that arose with regard to the construction of a new bridge over the Humber. Great opposition to the project by shipping interests, which contend that great damage may be done to the channel, has had to be met. On Monday, June 22nd, the Humber Bridge Bill was approved by a Select Committee of the House of Commons. Speaking on behalf of the Bill, Sir Leslie Scott, K.C., stated that the promoters were willing to amend the Bill to modify the construction of the bridge. The headway of the main span and of the anchor span on each side would be left at 105ft. above high water. The anchor spans would, however, be lengthened from 375ft. to 475ft., and the height of all the other spans, with the exception of one span on each side, would be increased to 80ft. The promoters were ready to accept the responsibility of keeping an open waterway without any regard to time, and would undertake to pay the cost of any works that might be necessary in the event of the main channel of the river being altered by the building of the bridge. It was pointed out for the Humber Conservancy Board that its resources would not extend to the building of training walls if they were found necessary, but the promoters wished to make the position clear by stating that such costs would be borne by them, the works to be undertaken to be agreed upon between the Bridge Board and the Humber Conservancy Board, or, failing agreement between them, any such costs might be determined by arbitration.

A Proposed River Dee Embankment.

IN our issue of December 13th, 1929, we described in these columns a scheme for the construction of a road and railway bridge and an embankment across the river Dee from West Kirby on the northern bank, to Talacre on the southern bank of the estuary. The scheme was prepared by Mr. T. R. Wilton, of Messrs. Wilton and Bell, of Westminster, and is being considered by the Dee Conservancy Board. On Thursday of last week a meeting of the Liverpool Branch of the Industrial Transport Association was held, at which an alternative scheme which has been prepared by Councillor Herbert H. Nuttall, of Liverpool, was outlined. Mr. Nuttall's proposal is that an embankment should be built between Hilbre Point in Cheshire, on the north side of the estuary, by way of the Eye or Hilbre Island, across the Hilbre Channel to the Point of Air in Wales. The bridge over the Hilbre Channel would consist, according to the plan, of twelve spans of 240ft., and the scheme provides for an embankment 80ft. wide, which would carry a double-track electric railway, a 36ft. roadway, and a promenade. The main channels of the river Dee would, it is proposed, be directed into the Mostyn Deep and would pass along the Flintshire coast to Connah's Quay. At all states of the tide navigation would be possible, it is stated, to all vessels of approximately 800 tons and 16ft. draught. In the course of a discussion of the scheme presented, Mr. J. A. Brodie, the late City Engineer to the Liverpool Corporation, while expressing his sympathy with the proposal of a Dee embankment, pointed out that starting to interfere with the channel of the Dee was no light task, and it was one that would have to be carefully approached. At the close of the meeting a resolution was passed asking for a Ministry of Transport inquiry to be instituted.

The New Chelsea Suspension Bridge.

ON Tuesday last, June 23rd, the London County Council agreed to the recommendation of its Improvements Committee that a new steel suspension bridge should be constructed across the Thames at Chelsea, to replace the existing structure. The cost of the new bridge will be about £659,250, and its design has been prepared by the architect to the Council in collaboration with Sir Frederick Palmer, P.P. Inst. C.E., the appointed engineer. A suspension bridge of steel design has been chosen rather than a steel bridge carried by concrete, and it will comprise a central span over the navigable water with two shorter approach spans. The total width of the bridge is to be about 98ft., which will include two footways, each 12ft. wide, and a carriageway 60ft. in width, sufficient for six lines of traffic. Although the type of bridge to be built has now been agreed upon, the Committee states that it has under consideration a suggestion by the Minister of Transport for the construction of a traffic circus at the northern approach. Should this plan be adopted it will be necessary to place the new bridge on a different line from that occupied by the existing bridge. The Committee is to report further on this aspect of the scheme, but the decision of the London County Council as to the type of bridge will enable the working drawings, &c., to be prepared.

A Factory Explosion.

THERE was a serious explosion at the Royal Naval Cordite Factory at Holton Heath, near Wareham, Dorset, last Tuesday, June 24th. It occurred in the nitrating house, and ten men were killed, while the washing house, the distributing house and paste mixing house were destroyed by the explosion and the fire that followed it. The cause of the accident is not definitely known yet, but it is stated that it was caused by nitro-glycerine. It probably took place in the open in an area close to a number of buildings in which men were working. Admiralty experts have been sent to the factory to investigate the matter. The factory employs between 1400 and 1600 people, who work in sheds which are separated from one another by earthworks. Thus each shed is isolated. It is owing to this fact that the fire which followed the explosion did not extend to other buildings. The explosion occurred at 10.45 a.m., and is reported to have been felt and heard 20 miles away. Owing to the bursting of an acid tank and the resulting flow of acid into the fire, thick fumes arose, but fortunately any possibility that they might spread over the countryside was prevented by the presence of the earthworks. Besides the ten killed, nineteen were injured; but, according to official reports, none of the latter are in a serious condition.

John Brown's Report.

THE report of John Brown and Co., Ltd., shipbuilders, engineers and colliery owners, of Sheffield and Clydebank, for the year ended March 31st last, shows that the profit for the year—including dividends from subsidies and on investments, and certain reserves of £23,714 no longer required, after deducting all expenses, directors' remunerations and depreciation, &c.—amounted to £124,118. The debenture interest and directors' and trustees' fees absorbed £113,586, leaving a net profit of £10,532, which compares with £24,185 for the preceding financial year, since when the capital of the company has been reconstructed. No dividends are to be paid on either the preference or the ordinary shares. The assets of the firm now total £4,864,617, as against £7,859,073 in the previous accounts. The report states that there was a steady decline throughout the past year in all the principal branches of trade, and at present there is little or no sign of improvement. The slump has adversely affected not only the company, but the market values of its investments in subsidiary companies. Although the value of such investments was written down under the reorganisation scheme last year, in the aggregate there has been further depreciation. The colliery results were again far from satisfactory, and the general outlook in the shipbuilding industry remains depressed owing to the unprecedented dearth of new orders for warships and mercantile vessels.

Shear Stresses in Helical Springs.

By L. E. ADAMS, B.Sc. (Eng.) Lond., A.M. Inst. N.A.

THE theory developed in this article is based on what the writer has called the "Röver Effect," after A. Röver, who in 1913 was perhaps the first to realise that the stress distribution in a spring, due to pure torsion, was not directly proportional to the distance of the spring fibre from the geometric centre of the section of the wire. The effect is present in all helical springs, due to the fact that the fibres of the metal at the inside of the coils are shorter than those at the outside. As a result, any small rotation of a plane section of the wire relative to a neighbouring section produces greater shear stresses in the inner fibres than in the outer fibres. It is clear that the effect will be greatest at the inner end of a horizontal diameter of a section, since it is there that the fibres are shortest. Thus, the "Röver Effect" further increases the maximum shear stress at the point of its maximum intensity as given by the usual theory for the maximum stress in which the shortening of the inner fibres is neglected. As might be anticipated, the increase is more marked in the case of springs whose "spring index"—*i.e.*, ratio of diameter of wire to mean diameter of the coils—is high, say, $>1/5$, than in springs in which this ratio is less than 1/8.

It appears that the "Röver Effect" has not received the attention due to it from spring designers, with, as far as the writer is aware, the exception of the work of A. M. Wahl for the Special Research Committee on Springs of the A.S.M.E.—"Stresses in Heavy Closely Coiled Helical Springs," and "Further Research on Helical Springs of Round and Square Wire," December, 1928, and June, 1930, respectively. Wahl deduced approximate formulæ for the maximum shear stress, based on the theory of bending of curved beams. His formulæ contain two terms, one purporting to represent the shear stress due to pure torsion, and the other making an allowance for the direct shear due to the axial load. It will be shown during the course of this article that the maximum shear stress deduced by Wahl from measurements of the principal strains, inclined at 45 deg. to the cross section of the semi-coil tested, agrees within 1·22 per cent. of the maximum shear stress, making due allowance for the "Röver Effect" and for bending stresses. In the semi-coil tested by Wahl the slope of the centre of the wire was $\tan^{-1} 0{\cdot}625/4{\cdot}38 = \tan^{-1} 0{\cdot}1428 = 8°\ 7'$ (approximately).

It may be shown that a slope of 10° in the helix of a spring of circular section increases the maximum shear stress due to the combined action of bending and twist by nearly 17 per cent. This consideration makes stresses derived by Wahl's formula to be from 7 to 17 per cent. too high. Röver also derived an approximate formula for the maximum shear stress, and apparently gave a rigorous mathematical solution in the case of a spring having an index $c = d/D = \frac{1}{4}$, based on the theory of elasticity—"Beanspruchung Zylindrischer Schraubenfedern mit Kreisquerschnitt," Z.V.D.I., 1913, page 1906. The writer has not seen Röver's solutions, but infers from Wahl's 1928 paper that he—in his approximate formula at any rate—neglected the displacement of the actual centre of rotation of the fibres from the geometric centre of the wire; also that Röver made no attempt to provide a new deflection formula.

The results derived in the following analysis are rigorous, and are believed to be the first giving the displacement of the centre of rotation, the maximum shear stress due to the "Röver Effect" and a more accurate formula for the axial deflection of a helical spring of circular section wire. The theory for springs having wire of non-circular cross section is made much more complicated by St. Venant's discovery that plane sections of such springs become distorted by torsion.

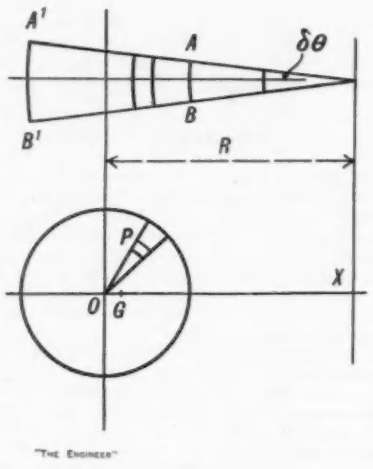


FIG. 1

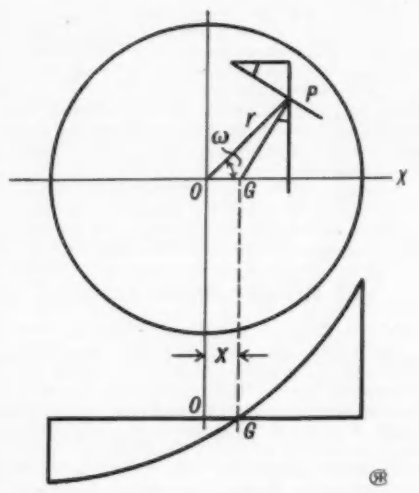


FIG. 2

Let d' = diameter of the section of the wire;
R' = mean radius of the coils;
D' = mean diameter of the coils;
$c = \frac{d}{D}$ = "spring index."

Consider an element $AA^1\ B^1B$ of the wire subtending an angle $\delta\theta$ at the axis of the spring—see Fig. 1.

Let $\delta\beta$ = relative angular rotation of AA^1 and BB^1 when the element is subject to a pure twisting moment T.

Since all the fibres to the right of the geometric centre O are shorter than the corresponding fibres to the left of O, it follows that the rotation $\delta\beta$ will produce greater shear stresses in the former fibres than in the latter. Now the torque T can only be balanced by a torque, due to the stresses in the fibres, of equal moment and of opposite sign; for this to be the case the centre of rotation of the fibres must be displaced from O to some point G. The distribution of shear stress across the section, due to T, is then somewhat as shown in Fig. 2. Let x' = displacement of G from O towards the axis of the spring. Consider a fibre at P whose polar co-ordinates are (r, ω) referred to O as pole and O X as the initial line.

Length of this fibre between AA^1 and BB^1
$$= (R - r\cos\omega)\,\delta\theta$$
Displacement of the fibre about G
$$= (G\,P)\,\delta\beta;$$
and $$G\,P^2 = O\,P^2 + O\,G^2 - 2\,(O\,P)\,(O\,G)\cos\omega$$
$$= r^2 + x^2 - 2\,r\,x\cos\omega$$
Angle of shear for the fibre
$$= \varphi = \frac{(G\,P)\,\delta\beta}{(R - r\cos\omega)\,\delta\theta}$$
whence shear stress in fibre $= N\varphi$
i.e., $$S = \frac{N\,\delta\beta}{\delta\theta} \times \frac{G\,P}{R - r\cos\omega} \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

Resolve S into components S_a and S_t parallel and perpendicular respectively to the axis of the spring. Then

$$S_a = S \cdot \frac{r\cos\omega - x}{G\,P}$$
$$S_a = \frac{N \cdot \delta\beta}{\delta\theta} \cdot \frac{r\cos\omega - x}{R - r\cos\omega} \quad . \quad . \quad . \quad (1A)$$
And $$S_t = S \cdot \frac{r\sin\omega}{G\,P}$$
$$S_t = \frac{N \cdot \delta\beta}{\delta\theta} \cdot \frac{r\sin\omega}{R - r\cos\omega} \quad . \quad . \quad . \quad (1B)$$

It will be noticed that S_t is independent of x. The value of "x" must be determined from the condition $\int S_a \cdot dA = 0$, for the case of pure torsion.

Area of element at $P = \delta A = r \cdot \delta\omega \cdot \delta r$

Hence we have

$$\int_0^{2\pi}\int_0^{d/2} \frac{N \cdot \delta\beta}{\delta\theta} \cdot \frac{(r\cos\omega - x)\,r \cdot d\omega \cdot dr}{R - r\cos\omega} = 0$$

Integrating this expression* and simplifying, we obtain

$$x = \frac{d}{4}\left\{2\left(\frac{1}{c}\right) - \frac{c}{1 - \sqrt{1 - c^2}}\right\} \quad . \quad . \quad . \quad (2)$$

Equation (2) fixes the excentricity of the centre of rotation of the fibres.

In order to determine the maximum shear stress, using either equation (1) or (1*a*), we require to know the value of $N \cdot \delta\beta/\delta\theta$; this may be found from the condition

$$\int S \cdot dA \cdot G\,P = T.$$

Inserting the values obtained previously, we get

$$\frac{N \cdot \delta\beta}{\delta\theta}\int_0^{2\pi}\int_0^{d/2} \frac{r\,(r^2 + x^2 - 2\,r \cdot x \cdot \cos\omega)}{R - r\cos\omega}\,d\omega \cdot dr = T$$

Performing the necessary integrations* and simplifying we finally obtain the result

$$\pi \cdot N \cdot K \cdot \frac{\delta\beta}{\delta\theta} = T \quad . \quad . \quad . \quad . \quad (3)$$

where

$$K = \frac{d^2}{12}\left\{d\left(c + \frac{1}{c}\right)\frac{}{\sqrt{1 - c^2}} + 6\,x\right\} - \frac{D}{6}\left\{D^2\left(\frac{1}{\sqrt{1 - c^2}} - 1\right) + 6\,x\,(D - x)\,(1 - \sqrt{1 - c^2})\right\} \quad . \quad . \quad (4)$$

From equation (3)

$$\frac{\delta\beta}{\delta\theta} = \frac{T}{\pi\,N\,K} \quad . \quad . \quad . \quad . \quad . \quad (3a)$$

where K has the dimensions L^3, and is given by equation (4).

Integrating (3*a*), we get

$$\left.\begin{matrix}\text{Total angular rotation}\\ \text{of the spring}\end{matrix}\right\} = \beta = \int_0^{2\pi n} \frac{T}{\pi\,N\,K}\,d\theta$$

in the case of a spring having "n" effective coils, *i.e.*,

$$\beta = \frac{T}{\pi\,N\,K} \cdot 2\pi n = \frac{2\,n\,T}{N\,K};$$

whence

$$\text{axial deflection} = \Delta = R\,\beta = \frac{2\,n\,R\,T}{N\,K},$$

and writing $T = W\,R$,

$$\Delta = \frac{2\,W\,R^2\,n}{N\,K} \quad . \quad . \quad . \quad . \quad (5)$$

This new formula for the axial deflection of a heavy closely coiled helical spring shows that the deflection is a function of the "spring index" (c) as well as of the diameter (d) of the section of the wire. Equation (5) also accounts for the discrepancy between the measured deflection of springs of circular section—"Further Research on Helical Springs of Round and Square Wire," by A. M. Wahl, Am. Soc. Mech. Engineers, June, 1930—and the theoretical deflection determined by the usual formula. This point will be amplified later in a definite example tested by Wahl.

Again, from equation (3),

$$\frac{N \cdot \delta\beta}{\delta\theta} = \frac{T}{\pi\,K}.$$

Substituting in equation (1*a*) gives

$$S_a = \frac{T}{\pi\,K} \cdot \frac{r\cos\omega - x}{R - r\cos\omega}$$

The shear stress will clearly be a maximum at the point $(d/2, 0)$; whence

$$S\ \text{max.} = \frac{T}{\pi\,K} \cdot \frac{d/2 - x}{R - d/2}$$
$$= \frac{T}{\pi\,K} \cdot \frac{d - 2x}{D - d} \quad . \quad . \quad . \quad (6)$$

We may compare this result with the maximum shear stress (f_s) given by the ordinary rule: thus

$$f_s = \frac{16\,T}{\pi\,d^3},$$

and

$$\frac{S\ \text{max.}}{f_s} = \frac{T}{\pi\,K} \cdot \frac{\pi\,d^3}{16\,T} \cdot \frac{d - 2\,x}{D - d}$$
$$= \frac{d^3}{16\,K} \cdot \frac{d - 2\,x}{D - d}$$

i.e.,
$$S\ \text{max.} = \frac{1}{2\,K}\left(\frac{d}{2}\right)^3 \cdot \frac{d - 2\,x}{D - d} \cdot f_s$$
$$= C_B \cdot f_s \quad . \quad . \quad . \quad . \quad . \quad . \quad (6a)$$

where

$$C_B = \frac{1}{2\,K}\left(\frac{d}{2}\right)^3 \cdot \frac{d - 2\,x}{D - d} \quad . \quad . \quad (6b)$$

The writer proposes to call "C_B" the "Röver factor" to commemorate the advance made by A. Röver on this subject in 1913.

Equations (6) and (6*a*) above give only the maximum shear stress in the material due to a pure twisting moment T. Due to the effects of direct shear stress across the section and to normal stresses caused by bending, the actual maximum shear stress in the material must be determined from

$$Q = \frac{F_1 - F_2}{2},$$

where F_1 and F_2 are the principal stresses. This can only be done (correctly) in any given case by actually combining the various stresses. The process is complicated by arduous arithmetical work, and the writer proposes to dispense with it, for ordinary practical purposes, by using another factor C_1; we then get—

$$\left.\begin{matrix}\text{Maximum shear}\\ \text{stress in the spring}\end{matrix}\right\} = C_1 \cdot C_B \cdot f_s \quad . \quad . \quad . \quad . \quad (7)$$

where "C_1" is a factor to allow for the effect of combined stresses.

The formulæ derived for S max., C_B and Δ are rendered unsuitable for easy practical application by the presence of the quantity "K," which equation (4) shows to be very cumbersome. To remove this disadvantage the author has carefully calculated, for springs of circular section, values of x, K, and C_B for

* The integrations referred to are very difficult and lengthy. They have been submitted to us in detail and we have examined and checked them. While we congratulate the author on the success with which he has carried out this arduous portion of his task, we have to express our regret that it is impossible for us to reproduce the steps involved in the integrations.—ED. THE E.

values of c varying from 1/3 to 1/10. The results are given in the following table, for the case in which $d=1''$.

Spring index (c).	x_1 ($d=1$in.).	K_1 ($d=1$in.).	Röver factor (C_R).
1/3	·042885	·02135277	1·3384
1/4	·031775	·01581936	1·233
1/5	·025243	·01262096	1·176
1/6	·020973	·01048149	1·142
1/7	·01796	·0089426045	1·123
1/8	·015874	·007859856	1·10
1/9	·013925	·006972887	1·089
1/10	·01247	·006282271	1·077

Seven-figure logarithms were used as four figures gave values of C_R totally inconsistent with the theory.

The values in the second and third columns hold only for a wire of diameter 1″. The figures for any other diameter (d_2) may be derived as follows :—

From equation (2)

$$x=\text{const.} \therefore d, \text{ for the same value of } c,$$

$$\therefore x_2=x_1 \cdot \frac{d_2}{d_1}=x_1 d_2, \text{ when } d_1=1'' \quad . \quad . \quad (2a)$$

Again the value of K given in equation (4) may be expressed in the form

$$K=\frac{d^3}{24}\left[2\left\{\frac{c^4+c^2-2}{c^3\sqrt{1-c^2}}+\frac{2}{c^3}\right\}+3\left\{\frac{2}{c}-\frac{c/2}{1-\sqrt{1-c^2}}-\frac{2\,(1-\sqrt{1-c^2})}{c^3}\right\}\right] . \quad (4a)$$

$=\text{const.} \therefore d^3$, for the same value of c.

$$\therefore K_2=K_1 \cdot \left(\frac{d_2}{d_1}\right)^3=K_1 \cdot d_2^3, \text{ when } d_1=1'' \quad (4b)$$

Also from equation (6b)

$$C_R=\frac{1}{2K}\cdot\left(\frac{d}{2}\right)^3\cdot\frac{d-2x}{D-d}$$

$$=\frac{d^3}{16}\cdot\frac{d-2x}{K\left(\frac{1}{c}-1\right)}$$

$=$ constant, provided the value of c be the same.

Hence the values of C_R given in the table, and calculated for $d=1''$, will apply to any other diameter of wire, provided the spring index be the same. In order to get the actual maximum shear stress in the material we must know the value of the constant C_1. The writer has shown elsewhere that $C_1=1\cdot17$ (nearly) when $c=1/3\cdot5$; approximate values of C_1 for other values of c may be taken as follows :—

$C_1=1\cdot12$ when $c=1/6$; $C_1=1\cdot07$ when $c=1/10$.

These values of C_1 are applicable when the coils of the spring are reasonably close and when care is taken to keep the loading nearly axial. If the spring is open coiled or the loading is not even approximately axial the value of C_1 must be increased accordingly.

To facilitate the finding of C_R, K_1 ($d=1''$) and $C_1\times C_R$, graphs are given—see Fig. 3—in which these

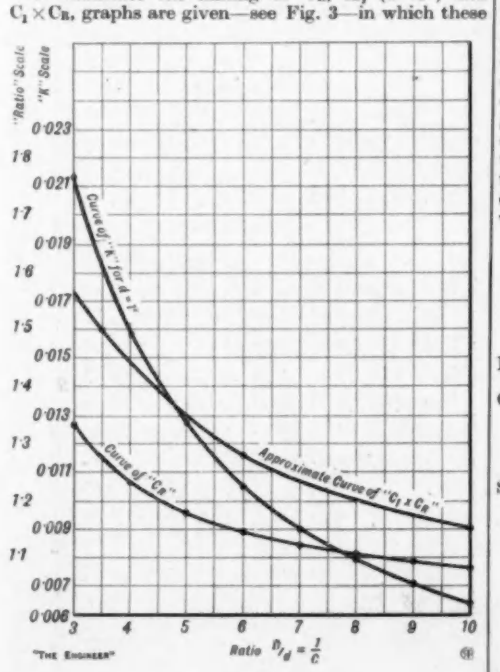


FIG. 3

functions are plotted on the reciprocal of "c" as a base ; the graphs permit of the rapid determination of the function desired for all values of $1/c$ from 3 to 10. Thus the curves in conjunction with the formulæ already derived enable the maximum shear stress in, and the axial deflection of, helical springs of circular section to be quickly and accurately determined. Springs which are subject to a periodic load—*e.g.*, engine valve springs—are liable to have a system of forced oscillation set up in them—"surging"—which effect will further increase the maximum stresses as well as the range of stress. No account has been taken of this phenomenon.

We proceed to compare the results given by the above theory with those obtained by the very careful experimental work of A. M. Wahl and the Special Research Committee on Springs of the A.S.M.E.

(1) *Rule for the Maximum Shear Stress.*—Taking the case of the semi-coil 2 of Wahl's 1928 paper, we have the following data :—

Diameter of wire $=d=1\cdot46''$.
Mean radius of semi-coil $=R=2\cdot19''$.
Mean diameter of semi-coil $=D=4\cdot38''$.
Spring index $=c=d/D=1/3$.

From the graph, Fig. 3,

$$C_1\times C_R=1\cdot565 \text{ when } \frac{1}{c}=3$$

With an axial load of 3000 lb. Wahl obtained a maximum shear stress—at the inner end of a horizontal diameter—of 16,620 lb. per square inch—scaled from Fig. 12 of Wahl's paper—by extensometer readings of the principal strains.

Applying the value $C_1\times C_R=1\cdot565$ in equation (7), we get

Maximum shear stress in semi-coil $=1\cdot565\times f\,s$.

Again,

$$f\,s=\frac{16\ T}{\pi\,d^3}$$

$$=\frac{16\times3000\times2\cdot19}{\pi\times1\cdot46^3}$$

$$=\frac{6\times2190}{\pi\times\cdot73^3}$$

$$\text{Maximum shear stress}=\frac{9\cdot390\times2190}{\pi\times\cdot73^3} \text{ lb. per sq. in.}$$

$=16{,}822\cdot5$ lb. per square inch.

This calculated stress is within 1·22 per cent. in excess of Wahl's measured stress, and such a slight error would lie within the experimental accuracy of the readings.

(2) *Rule for Axial Deflection.*—To check this rule we shall consider two springs tested by Wahl, the data being taken from his 1930 paper.

(*a*) Spring 3A (see Table I. of Wahl's paper) :

Mean diameter of the wire $=d=0\cdot62''$.
Mean diameter of the coils $=D=1\cdot664''$.

$$\text{Spring index}=c=\frac{d}{D}=\frac{1}{2\cdot683}=0\cdot3727.$$

Since the index of this spring lies outside the range covered in Fig. 3, we apply equations (2) and (4) to find "x" and K respectively, obtaining

$$x=0\cdot030194''\ ;\ K=0\cdot0056682.$$

Substituting in equation (5) gives

$$\text{Axial deflection}=\frac{2\ W\ R^2\ n}{N\ K}$$

$$=\frac{2\ W\times0\cdot832^2\times5}{11\cdot5\times10^6\times0\cdot005668}$$

$$=0\cdot000106195\ W$$

$=0\cdot106195''$, when W $=1000$ lb.

$n=5$, $N=11\cdot5\times10^6$—*vide* Wahl's Table II.

Wahl determined the deflection by taking the mean of the deflections measured at diametrically opposed points on the spring, thereby eliminating the effect of excentric loading. Fig. 19 of his paper gives an axial deflection—mean test value—of 0·1067″ for an effective load of 1000 lb.—figures scaled from Wahl's graph. The discrepancy of 0·000505in. between the calculated and measured deflections is explained by the fact that Wahl states, on page 224 of his paper, that "for the small springs the accuracy of the cathetometer (used for measuring the deflections) was within about 0·001″."

(*b*) Spring 3C—see Table I. of Wahl's paper :

Mean diameter of the wire $=d=0\cdot6207''$.
Mean diameter of the coils $=D=5\cdot9''$.

$$\text{Spring index}=c=\frac{d}{D}=\frac{1}{9\cdot506}=0\cdot1052.$$

From Fig. 3 we find that when $\frac{1}{c}=9\cdot506$, $K_1=0\cdot0066$. Hence for the spring under consideration

$$K_2=K_1\times d_2^3 \quad . \quad . \quad . \quad . \quad . \quad . \quad (4b)$$

$$=0\cdot0066\times0\cdot6207^3$$

$=0\cdot0015783$ inch^3 units.

Substitute in equation (5) and we get—

$$\text{Axial deflection}=\frac{2\ W\ R^2\ n}{N\ K}$$

$$=\frac{2\ W\times2\cdot95^2\times4}{11\cdot5\times10^6\times0\cdot0015783}$$

$$=0\cdot0038357175\times W$$

$$=0\cdot00383572\times523\cdot2\ ;\ \text{when W}=523\cdot2$$

$=2\cdot00685''$

$n=4$; $N=11\cdot5\times10^6$.

Wahl's measured deflection—see Fig. 21 of his 1930 paper—for this load was 2·0″, the accuracy of the measurement being "around 0·01″." Thus the calculated and measured deflections agree, within the limits of experimental accuracy.

The theoretical results deduced above are thus seen to be in very close agreement with the careful experimental work of the Special Research Committee on Springs of the A.S.M.E.

It should be noted that the value of "K" given by equation (4), and used in conjunction with equation (5), applies only to springs of circular section wire. Equation (7) may be applied to springs of square section, provided Saint Venant's value for "$f\,s$" be used, viz.,

$$f\,s=\frac{T}{0\cdot208166\ s^3}$$

where T $=$ W R $=$ torque on the spring, $s''=$side of the square section.

H.M.S. Acheron.

H.M.S. "ACHERON" is one of the "Acasta" class of destroyers, and has a designed speed of about 35 knots at an output of about 34,000 S.H.P.; her displacement is 1330 tons, with a length of 312ft. between perpendiculars. Her armament comprises four 4·7in. guns, two 2-pounder pom-poms, five machine guns, and eight 21in. torpedo tubes on quadruple mounts.

The contract was placed by the British Admiralty with the Parsons Marine Steam Turbine Company, Ltd., Wallsend-on-Tyne, which constructed the turbine machinery and fitted the complete installation on board the vessel, the hull and boilers being built by John I. Thornycroft and Co., Ltd., at Woolston, Southampton.

The distinguishing feature of this vessel is to be found in the main engine and boiler rooms. The British Admiralty, in the search for further economies in propelling machinery for the ships of His Majesty's Navy, made a distinct departure from the machinery of the latest class of destroyers by adopting higher steam pressures and temperatures for H.M.S. "Acheron," the boiler pressure being 500 lb. per square inch, with a total steam temperature of 750 deg. Fah., as compared with a boiler pressure of 300 lb. per square inch and a total steam temperature of 600 deg. Fah. in the other vessels of the "Acasta" class. In our two-page Supplement and on page 700 we reproduce drawings and photographs illustrating the turbines and boilers of the vessel.

THE MAIN PROPELLING MACHINERY.

The propelling machinery is arranged on two shafts, the driving unit of each consisting of four high-speed turbines coupled to the shaft through reduction gearing. The proportion of power developed by the respective turbines is approximately as follows :—H.P., 18 per cent.; first I.P., 23 per cent.; second I.P., 26 per cent.; L.P., 33 per cent. End-tightened blading is fitted throughout the reaction stages of the H.P. ahead turbine and throughout the first I.P. ahead turbine in order to obtain the highest efficiency under all conditions of steaming.

Monel metal is used for the reaction blades of the H.P. turbine and of the first expansion of the first I.P. turbine, and manganese copper for the remaining expansions of the first I.P. The remainder of the ahead reaction blades are of 70/30 brass ; in the astern turbine the blades are of stainless iron. The ahead and astern impulse blades are of stainless steel and the nozzle vanes are of A.T.V. steel cast into phosphor-bronze matrices.

The high-pressure cylinders have heavy flanges with high-tensile steel bolts and studs and wrought iron nuts. The flanges are relieved by saw cuts at each bolt hole.

Expansion of the turbines is adequately provided for, and the main steam lines are arranged with corrugated bends to give the required elasticity.

Special attention was given, in the design stage, to the ventilation of the engine-room in view of the high steam temperature, and the insulation of the heat radiating surfaces also was very thoroughly considered. As a result the engine-room under all conditions of running is very cool and the comfortable condition of both boiler and engine-room spaces was most noticeable on the trial.

The surfaces of the high-pressure turbine casings are lagged with special magnesia about 1in. thick, applied in a plastic condition and covered with sectional magnesia blocks fitted in contact. An air space is left between the inner insulation and the ½in. thick asbestos millboard secured to the cleading plates. The high-temperature steam pipes and fittings are lagged with special magnesia sectional blocks between covers of asbestos cloth. The joint flanges are fitted with magnesia mattresses specially arranged for easy removal and examination of the pipe joints when desired.

All the auxiliary machinery is arranged to work with steam at a reduced pressure of 300 lb. per square inch and to exhaust against a back pressure of 35 lb. per square inch. This arrangement involved very little departure from the established practice of the makers of this class of machinery. The reduction in the steam pressure is obtained partly by use of reducing valves and partly by restriction in the sizes of the auxiliary steam pipes and connections.

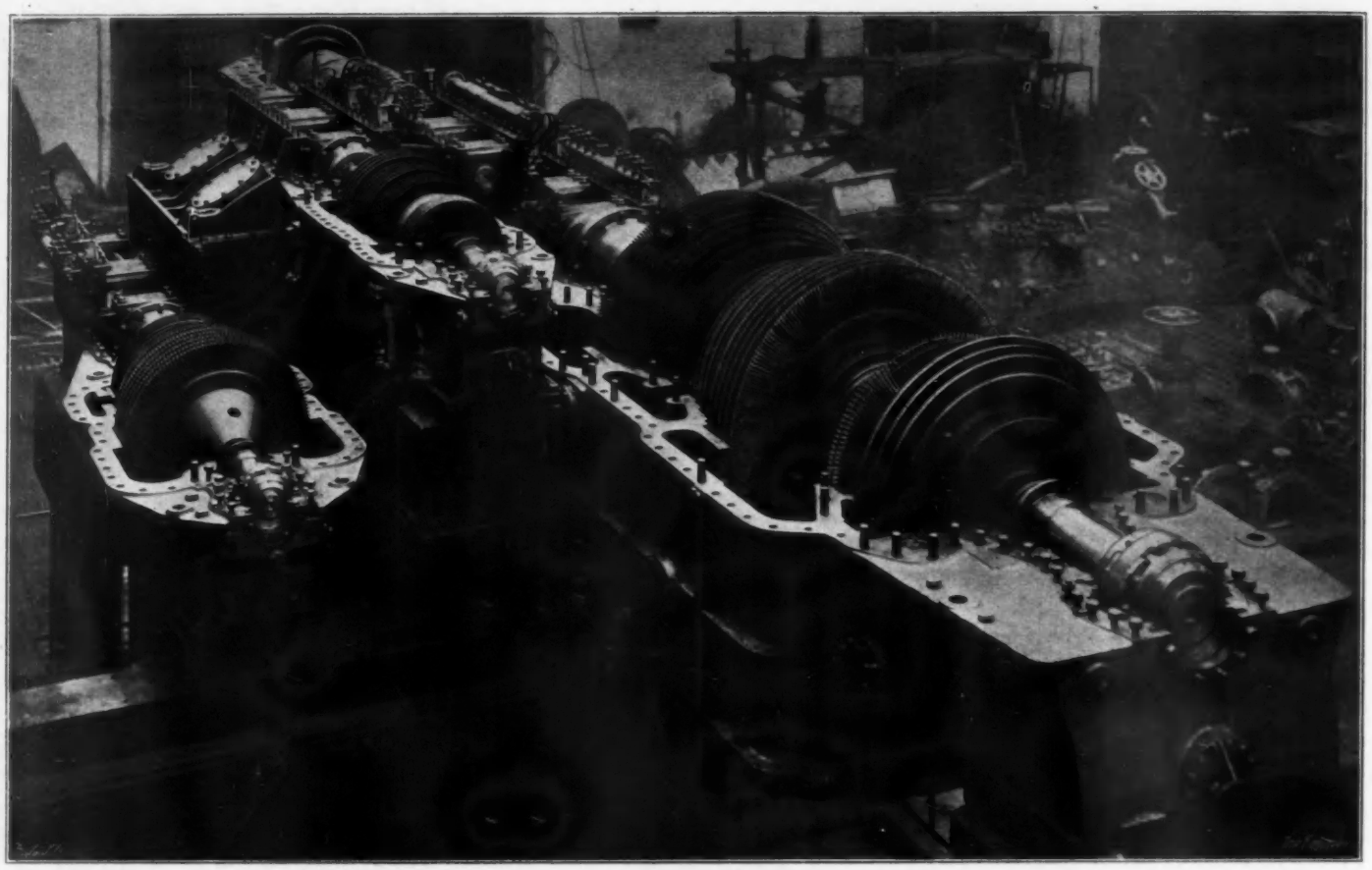
Steam enters the H.P. ahead turbines through nozzles which are specially grouped for use under low power and cruising conditions. Under full-power conditions H.P. steam is admitted direct to the reaction portion of the H.P. turbine, but a flow of steam is maintained through the impulse nozzles of the cruising element under all powers.

Labyrinth packing is fitted in the glands arranged at each end of each turbine, with suitable pockets and connections for the control of the supply and leak-off steam as required for sealing purposes.

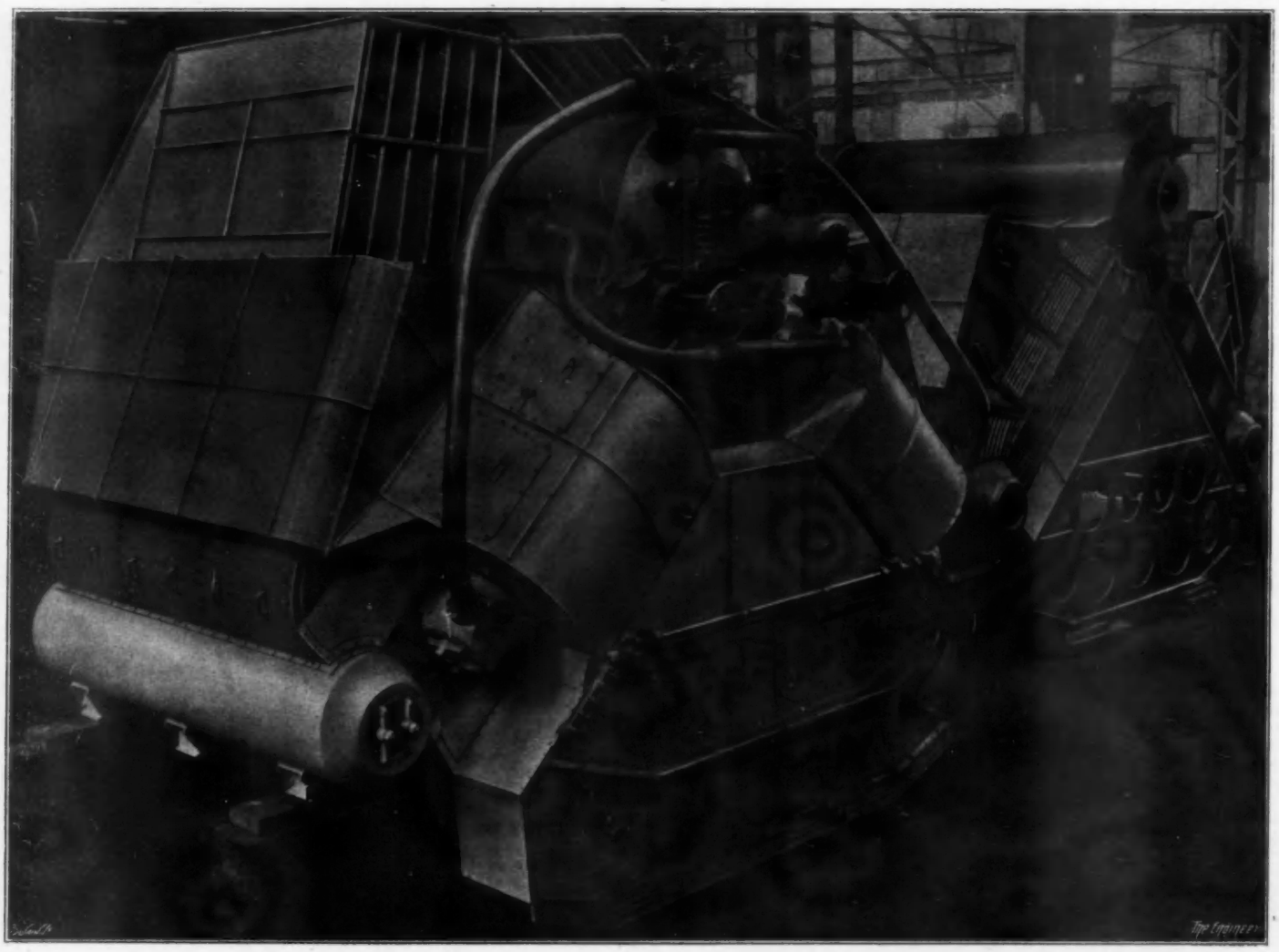
The screwed column type of lifting gear is supplied for all turbines and permits ready examination of the rotors, blading, &c. Suitable doors are arranged on the gear cases for examination of the pinion and gear wheel teeth. The gearing is of the double helical type, the wheel being built up of steel plates, with loose rims bolted on, in accordance with usual naval

H.M. DESTROYER "ACHERON"

THE PARSONS MARINE STEAM TURBINE COMPANY, LTD., WALLSEND-ON-TYNE, CONTRACTORS



STARBOARD TURBINE UNIT



HIGH-PRESSURE THORNYCROFT BOILERS

practice. The main thrust block is of the single-collar self-adjusting pivoted type.

The condensers are connected directly to and underneath the L.P. casing and arranged with rolling chocks to obviate distortion of the cylinder casing when the vessel is rolling heavily. Rolled steel plate and angle construction is used for the condensers, which are of the single-flow type. The circulating water inlets and discharges are arranged to give a scoop effect, which is assisted, as required, by turbo-driven geared circulating pumps. This arrangement was found to work very satisfactorily throughout all the trials.

The port and starboard propelling units are entirely separate and may be independently operated as desired. The manœuvring valves are arranged at the forward end of the L.P. turbine and the necessary pressure gauge boards, telegraphs and other instruments are conveniently placed in clear view of the engineer on watch.

Forced lubrication pumps—one turbo-driven, working, and one motor-driven, standby—are fitted adjacent to the two oil drain tanks, which are arranged at the aft end of the engine-room in order to obtain the maximum fall from the turbines and gearing. All turbine and gearing bearings, the main thrust blocks, and the gearing are lubricated on the forced pressure system. Sight flow indicators are fitted in the drain pipes from each bearing. Oil coolers are fitted to maintain a constant temperature of oil in the system, and strainers in the discharge pipes to catch any foreign material before it can enter the system. An oil separator is fitted to cleanse the oil of dirt or water.

Water extraction pumps and two-stage air ejectors draw the water and air from the condensers. A well is arranged in the base of each condenser to provide a reserve supply for the water extraction pump when no steam or make-up water is entering the condenser. The level of water in this well is regulated by float-controlled overflow and make-up feed valves having connections to or from the main feed tank. A hand-regulated make-up feed connection is also provided from the reserve fresh water tank. The boiler feed connections are arranged on the closed feed system. The water extraction pumps deliver through the air ejector coolers to the main feed pumps, thence through feed heaters to the feed water regulators on the boiler steam drums.

An emergency turbo-driven feed pump for each boiler is arranged to draw from the reserve feed tank, and the pumps are kept primed and ready for instant operation by a small motor-driven air extraction pump fitted in each boiler-room.

For harbour use the exhaust steam from the auxiliaries in use is led to a combined drain cooler and auxiliary condenser which is circulated by sea water. The drainage therefrom passes through a filter and thence to the main feed tank. A de-aerator system is provided and comprises a de-aerator, a motor-driven combined extraction and lift pump and a separate turbo-driven harbour service feed pump. Water drawn from the main or reserve fresh-water tank is freed from its air content in the de-aerator and discharged by the extraction pump direct to the harbour service feed pump.

Two turbo-driven generators are fitted in the engine-room, each having an output of 80 kW at 230 volts. A 20 kW oil-driven generator is fitted at the forward end of the vessel for harbour and general use as required.

A 50 tons capacity evaporating and distilling plant is fitted in the engine-room having connections for using both main boiler steam and exhaust steam from the auxiliary range. The pumps are motor-driven and are of the rotary type.

An electro-hydraulic steering unit is fitted in a compartment directly above the rudder.

THE BOILERS.

The boiler-rooms, two in number, are arranged on the closed stokehold system, air being supplied by six forced draught fans, which are turbo-driven geared units. The forward room has one boiler and the aft room two boilers, as usually arranged. The boilers are of the three-drum small tube type, designed by John I. Thornycroft and Co., Ltd., in collaboration with the Admiralty.

The barrels are of forged steel with ends closed in, and are machined internally and externally. The generating tubes are of solid drawn steel, the two fire rows being 1¾in., the next four before the superheaters 1¼in., and the remainder 1½in. external diameter.

To each boiler superheaters are fitted, of the two-flow hair-pin type, with solid forged cylindrical headers. The ends of the headers are solid with the barrels, and to avoid fitting riveted pads, the barrels are thickened in way of mountings. The tubes are 1¼in. external diameter, and of low carbon steel. They lie horizontally in the nest of generating tubes, the headers being parallel to the front of the boiler. This type of superheater is as used in practically all Admiralty vessels fitted with superheat boilers, and is similar to that adopted as far back as 1914, in the "Meteor" and "Mastiff," designed and built by Messrs. Thornycroft. These earlier designs referred to were not, however, so ambitious in respect of degree of superheat and utility over extended ranges of power, and in order to obtain improvements in these respects a series of experiments was carried out by the Admiralty, with the result that the superheat can now be maintained over a wide range of boiler forcing. The results of these experiments have been embodied in the present boilers.

The "Acheron's" boilers were designed for a superheat of 730 deg. to 750 deg. Fah., at full power, and when burning oil at the rate of ·785 lb. per square foot of heating surface a superheat of 725 deg. Fah. was obtained.

Owing to the restrictions on weight and space it was not feasible to fit large air heaters, and the surface is only 1650 square feet to each boiler. To obtain the best results possible from these heaters, experiments were carried out by the Admiralty on a boiler at the Haslar Experimental Station, with the result that tubular heaters were adopted. The rise in temperature over the heater tubes was 135 deg. Fah., at the above-mentioned rate of burning. After leaving the air heater proper the air is led down the back of the boiler, and then divides, a portion going under the furnace and the remainder along the side casings to the boiler front.

The burners and combustion tubes are of the latest Admiralty design, and, in addition to giving a correct mixture of air and oil, the combustion tubes were specially designed to offset as far as possible the increase in stokehold air pressure necessitated by air heaters. As the air pressure in the stokehold at full power is only 3½in., it will be seen that this object has been satisfactorily attained. The oil fuel pumps, three in number, are of the direct-acting type, with six filters, three for the cold oil and three for the hot oil. Two oil heaters of the U-tube type are fitted in each boiler-room. The aft heaters have double the surface of the forward heaters. A three-throw hand oil fuel pump is also fitted in each boiler-room for lighting up purposes.

Safety valves of the full-bore type are fitted for superheated and saturated steam, these valves being set at 505 lb. and 515 lb. per square inch respectively. The feed regulators are of the Contraflo type. Air is supplied to the stokehold by single-breasted turbo-fans, diffusers being fitted at the outlet of each fan.

RECORD ECONOMY.

During a recent exhaustive series of trials on the Clyde, the "Acheron" set up a new record in fuel economy for steam propelled naval vessels, the oil fuel consumption on the full power trial being 0·608 lb. of oil per shaft horse-power for all purposes when the boilers were burning 0·785 lb. of oil per square foot of total heating surface, the water consumption being 7·77 lb. per shaft horse-power. A high fuel economy was also obtained at reduced powers, namely, at 60 per cent. of full power the oil fuel consumption was 0·675 lb. per shaft horse-power, and the water consumption 7·93 lb. per shaft horse-power; at 10 per cent. of full power the oil fuel consumption was 0·92 lb. per shaft horse-power and the water consumption 12·87 lb. per shaft horse-power, the above figures of oil and water consumption being for all purposes.

Incorporated Municipal Electrical Association.

No. II. (*Conclusion*).*

ASSESSMENT.

THE discussion on a paper by Mr. Isaac Dixon, dealing with the assessment of electricity supply undertakings for local rating purposes, which was read on Wednesday, June 17th, revealed a general feeling that the author of the paper had proceeded too much on the lines that the law is what it is and must be complied with, and had failed to suggest improvements in it with the object of arriving at greater uniformity throughout the country.

Councillor Coates, the Chairman of the Watford Electricity Committee, remarked that in the case of certain undertakings selected by the author, the local rates represented no less than 8 per cent. of the gross receipts. He made the point that under the present system, the more progressive an industry is, the more highly it is taxed in proportion, and suggested that in view of the increase of taxation, it would pay the electricity supply industry to stand still for awhile.

Mr. J. N. Waite, the engineer to the Hull Corporation electricity undertaking, pointing out that the fundamental basis of assessment was the ability to pay, suggested the adoption of the policy of reducing charges to the consumer to such an extent that there would be no profits and therefore no rates to pay.

Alderman W. Walker, chairman of the Manchester Electricity Committee and a member of the Central Electricity Board—but speaking in the former capacity—also pressed the need for uniformity of assessment throughout the country if the industry was not to continue dissatisfied. Under the present system there was the possibility of one undertaking benefiting at the expense of another under the operation of the "grid," because the Central Board, in fixing its "grid" price, would make the greatest use of those stations at which the cheapest units were generated. (That was a possibility pointed out in the paper.)

Mr. T. Roles, chief engineer of the Bradford Corporation electricity undertaking, said the varying assessments now made indicated either that rating valuers did not know their own business or the law was capable of so many interpretations that it should be altered. It really became a question as to whether it paid to install highly efficient plant in order to reduce the cost of the unit because the benefits so obtained were likely to be more than counter-balanced by the increase in the assessment.

Other speakers took the same line, and Alderman Vorley, of Islington, pointed out how undertakings with heavy capital expenditure and a bad load factor were penalised, as against undertakings with a better load factor and lower capital expenditure, but with the same output. He also contended that derating should be applied to electricity supply undertakings in respect of industrial power, so that the charges for such power could be reduced.

The author, in his reply, again adopted the attitude that Parliament had decided the law, and we must conform to it, at the same time warning those who had suggested certain expedients for avoiding the law that they would not be able so to hoodwink the rating surveyors. On the question of uniformity of assessment, he claimed that the Valuation and Rating Act of 1925 had not yet got properly to work, and said that uniformity could not be expected in one assessment period of five years.

DISTRIBUTION.

On Thursday morning, June 18th, a paper was read by Mr. A. Nichols Moore, engineer at Newport, Mon., bearing the title "The Future Development of Electricity Distribution in Great Britain." It contained a vast amount of information regarding what is being done both here and in other countries in increasing the sales of electricity, and at the same time emphasised the point that even the national "grid" system here is not likely to reduce the price of electricity. Therefore it is in distribution and increased sales that further reductions in price must mainly be looked for. Hence, the author devoted considerable attention to the problem of how best to tackle the problem of distribution in this country in order to reduce the cost to the consumer. He suggested that the only possible means of doing this is to treat the country on the basis of distribution areas, on the lines of the areas delimited for the purposes of generation, and to have a Central Electricity Distribution Board with Regional Electricity Distribution Boards operating in the particular areas and working under the general direction of the Central Distribution Board. All local authority and company undertakings, as such, would be eliminated, and transferred to and vested in the Regional Distribution Boards on terms to be agreed. The Central and Regional Boards, it is suggested, should be appointed by the Minister of Transport, each Regional Board consisting of, say, ten members, some of whom would be nominated by the Central Distribution Board and the remainder by the various interests affected. Each Regional Board would be responsible for administering and developing electricity distribution as a real public utility within its own area.

The financial operations necessary to effect the transfer of undertakings representing some £330,000,000 are not regarded as particularly serious; indeed, the author referred to them as basically simple, and as not creating any disturbance of capital. He takes as his model the London Passenger Transport Bill. Broadly speaking, the scheme is that under the general control of the Central Distribution Board there would be Regional Distribution Boards operating as complete independent entities, issuing regional distribution stock under conditions and terms settled by Act of Parliament, dealing with their own finances, meeting all charges and interest payments, providing for redemption, reserve, superannuation and compensation, and administering surplus as may be decided as being in the best interests of the consumers, and of the industry. The financial operations being consolidated would be reduced to the simplest form, and the legal complications, unavoidable in the present system, would largely disappear. Jealousies and antagonism of interest, wasteful and expensive competition, would no longer dissipate the energy, time, and revenues of the industry, and the way would be made clear for the full administration and development of distribution.

The proposals of the paper met with a mixed reception in which a strong aversion to any further control of the industry on national lines was evident. Alderman Vorley, of Islington, claimed that much that the author had suggested in connection with the Regional Distribution Boards could be done by Joint Electricity Authorities, which might be established under existing legislation. The only justification for such Boards would be the savings in distribution which could be made and the reductions in charges to the consumers which would follow their operations.

Mr. H. C. Lamb, chief engineer to the Manchester Corporation Electricity Department, contended that the present municipal system had worked extremely well, and although he did not anticipate that we should continue for all time on the present lines, he prophesied that it would not be easy to bring about the violent change suggested in the paper. On the question of

* No. I. appeared June 19th.

unified charges—the analogy of the Post Office being quoted in the paper—Mr. Lamb expressed the view that if that were to come about the country might as well adopt communism at once, because, in that event, the rural and urban areas would be getting cheap electricity at the expense of those in the industrial areas.

Mr. F. W. Purse, Chief Engineer to the London and Home Counties Joint Electricity Authority, and until two years ago electrical engineer to the West Ham Corporation, expressed the view that unless electricity undertakings took advantage of the existing opportunities for dealing voluntarily with the distribution of electricity over large areas, some such scheme as that outlined in the paper would be put upon them compulsorily. He recalled that it was due to the failure to co-operate on the generating side that the Act of 1926 came into force. On the question of a unified price he rather imagined the author was referring to a uniform grid price in the regional areas and not to a uniform price all over the country.

Lieut.-Colonel W. A. Vignoles, late director and secretary of the British Electrical Development Association, and now managing director of Evershed and Vignoles, Ltd., strongly doubted whether Regional Distribution Boards could improve on what is being done in all the large industrial areas of the country to-day, and deprecated an addition to the already existing national authorities controlling the electricity supply industry. Mr. Purse, he said, was speaking for London, where there were special difficulties, but even there a great deal could be done by the Joint Electricity Authority, and the same remark applied to other parts of the country.

The author, like all other authors at the Convention, was not able to give a full reply in the time allotted, but he stuck to the point of the paper that the whole tendency is towards some such policy as he had outlined.

The Lighting Load.

The final paper of the Convention was read on Thursday afternoon, June 18th. It was by Mr. C. W. Sully, director of the Electric Lamp Manufacturers' Association of Great Britain, and dealt with "The Value of the Lighting Load to Authorised Undertakings." The paper demonstrates the great expense lamp manufacturers have been put to in evolving present-day forms of high efficiency lamps, but it is claimed that whilst service departments form an important part of most undertakings, in the main these departments have given little, if any, attention to the development of the lighting load. It is, therefore, urged that there should be attached to all undertakings a staff familiar with tariffs and capable of giving first-hand advice on lighting to all consumers. Speaking of what the lamp manufacturers have done, on their part, to provide efficient means of lighting, Mr. Sully said that all E.L.M.A. manufacturers have, during the past four years, arranged to have quantities of their "mass production" collected each month and submitted to tests conforming with the B.E.S.A. specification, by independent laboratories. These tests, during recent months, show that the average test lives of all the more popular lamps exceed 1500 hours, and that the gas-filled types have a 5 per cent. better test life than the vacuum types. Many data were given in the paper indicating the wide field for expansion of lighting, the general advantage to the load factor of the undertaking arising from an increase in lighting consumption being stressed.

In the discussion, Mr. W. F. T. Pinkney, of the Newcastle-on-Tyne Electric Supply Company, pointed out that a 4 per cent. increase in supply pressure was sufficient to reduce the life of the modern lamp by 50 per cent., yet supply authorities were permitted to have a variation of 4 per cent., plus or minus. He hoped, therefore, that the lamp manufacturers would produce a lamp which would not have its life halved in that way.

The Dinner.

The annual dinner of the Association was held at the Grand Hotel, Scarborough, on Thursday, June 18th, the guest of the evening being Mr. Herbert Morrison, Minister of Transport, who again made a propaganda speech in favour of a forward policy in the development of electricity. At the same time, he hinted at the possibility—although he said he knew he was on debatable ground—of distribution being dealt with on the lines suggested in Mr. Nichols Moore's paper unless supply authorities voluntarily took steps in the right direction. The President (Mr. A. J. Fuller), in the course of his reply, referred to sulphur and grit emission from our new large power stations, and claimed that as a result of the experiments carried out at Fulham and by the London Power Company, it could be claimed that sulphur and grit emission could be, and would be, largely eliminated. At the same time, he pointed out that a sulphur emission plant could not be tacked on to an existing generating station, but must be an integral part of the original design.

At the annual general meeting, which was held on Friday morning, June 19th, Mr. C. G. Morley New, chief electrical engineer at Cardiff, was elected President for the coming year, and the Association was cordially invited to hold the Conference there in 1932. During the meeting, a gold watch and cheque was presented to Mr. A. C. Cramb, whose resignation from the honorary secretaryship after 11 years in that position, was accepted with extreme regret.

Although there were no papers of purely engineering interest this year, the Convention was highly successful, the attendance at the various meetings being probably larger than at any previous Convention. The electrical exhibition, which has now become a regular feature, also continues to increase in size.

The Construction of a Canadian Diversion Canal.

An important project was completed at the end of last year at the site of a large hydro-electric power development at Chute-a-Caron, on the Saguenay River, in the province of Quebec, for the Alcoa Power Company.

Chute-a-Caron is situated on the Saguenay River, about 10 miles upstream from the town of Chicoutimi. The load requirements of the Isle Maligne plant of the Duke-Price Power Company, situated on the Saguenay River, about 9 miles below the outlet of Lake St. John and about 23 miles upstream from the Chute-a-Caron plant, fixed the capacity of the diversion works at the latter place at 50,000 cusecs. But owing to frequent flood peaks, there could be no assurance of a long uninterrupted period when the flow would be 50,000 cusecs or less, so that it was necessary to arrange the cofferdam structures in such a way that intermittent floods of more than that volume could be safely passed. Lake St. John storage above the Isle Maligne dam was available to a limited extent as a help in controlling stream flow during the diversion period.

While the Chute-a-Caron plant was under construction, it was necessary to divert the flow of the river only during the period between the tipping of an "obelisk"—referred to later—and the completion of the closure section of the dam. The latter operation entailed the placing of about 120,000 cubic yards of concrete, equivalent to 2½ months of uninterrupted work.

Fig. 1 shows the general lay-out. The diversion is divided into three sections, namely, the diversion canal, the sluice tube, and the tail-race. The diversion canal begins at survey station 2+00, and continues downstream to the face of the intake and entrance to the sluice tube at survey station 17+94·7. Under the intake and power-house on the centre line of No. 1 generator, a tunnel or sluice tube was constructed which connected the diversion canal to the permanent tail-race. The water was taken from the Saguenay at the entrance to the diversion canal, along the canal, through the sluice tube into the tail-race, and was finally passed back into the Saguenay at the end of the tail-race at survey station 45+00. The overall length of the excavated channel was about 4300ft. The material encountered was rock, with no overburden in the vicinity of the power-house, and considerable gravel overburden at the upstream end of the diversion canal and the middle portion of the tail-race.

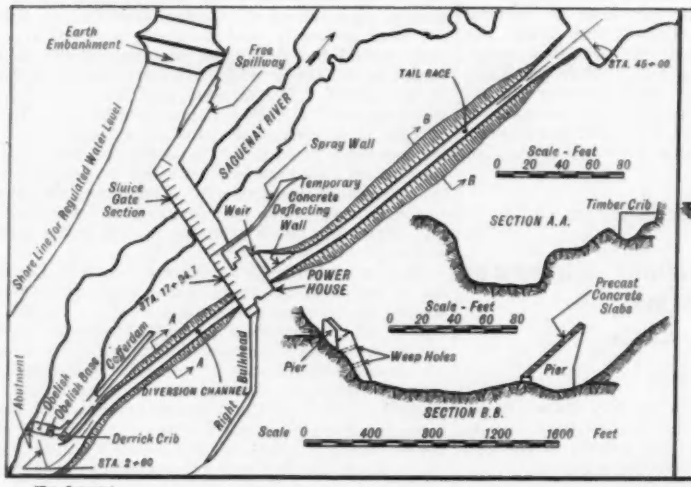


FIG. 1—PLAN SHOWING DIVERSION CANAL

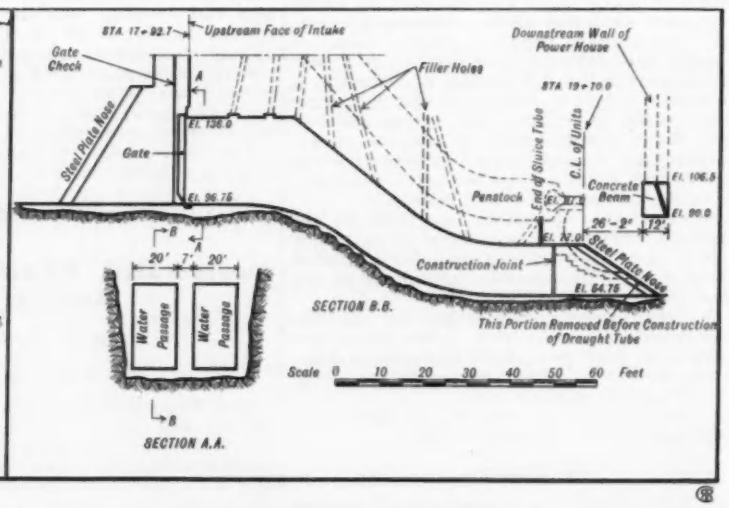


FIG. 2—ARRANGEMENT OF SLUICE TUBE

Fig. 1 shows a typical cross section of the tail-race channel and the concrete lining provided. The rock in the left bank stood at a fairly high elevation throughout, although the quality was poor in places, and it was necessary to protect this poor rock from erosion by a concrete slab covering. Weep holes were provided to prevent any back pressure, which might tend to separate the slab from the rock during low flow periods in the tail-race. This part of the lining

The Diversion Canal.

The theoretical cross section of the diversion canal had a width of 40ft. at the bottom with side slopes 1 to 4. As the excavation proceeded, it was found that this cut was too narrow to handle the work properly, and the channel was widened to provide space for a ramp tract on the right bank. A typical cross section is shown in Fig. 1. The canal was designed to have a capacity of 50,000 cusecs at a velocity of 21·25ft. per second. A roughness factor n of 0·045 was assumed, as it was considered uneconomical to do any trimming of the sides and bottom. It was believed from observations and flow measurements that the roughness factor was probably less than that assumed, but it has not been possible to establish the fact mathematically, owing to the effect of certain unknown factors, such as the time lag of the flow changes between Isle Maligne and Chute-a-Caron and the recovery of velocity head at points of variation in the section.

The Tail-race.

The cross section on which the hydraulic studies were based had a theoretical width of 50ft. at the bottom with side slopes of 1 to 4. This section was sufficiently large to keep the velocity within the required limits, and at the same time allow ample width for excavating purposes. In the central portion of the tail-race a heavy gravel overburden was encountered on the right bank which increased the width of the excavation, as the gravel necessitated flatter side slopes. Under these conditions the gradient of the tail-race bottom was increased to counterbalance the greater width, and the resulting tail-race, particularly the central portion, does not bear much resemblance to the theoretical.

Hydraulic studies of the tail-race were carried out simultaneously with those of the diversion canal. A roughness factor $n=0·035$ was assumed, as it was necessary to give more attention to trimming the side slopes and bottom, owing to the fact that this portion of the work was to be the permanent tail-race after the diversion had been completed. Owing to the type of lining used and the turbulence of the water, it has been impossible to obtain any information of value with regard to the roughness factor. The velocities varied from 50ft. per second at the power-house to about 30ft. per second in the lined portion of the canal.

Under operating conditions, for a full plant load of 18,000 cusecs and normal tail-water, the average velocity in the tail-race will be considerably higher than is ordinary. The size of the tail-race was limited for reasons which, being purely economical as applied to this particular development, would probably not apply to a development designed to operate under other conditions.

was poured in place with the exception of a few pre-cast slabs, which were used at the higher elevations. On the right bank the rock was low, with gravel overburden for a considerable portion of its length. This gravel overburden was protected from water flowing at high velocity by pre-cast concrete slabs, supported by concrete buttress piers.

The Sluice Tube.

The sluice tube, through which the water passed from the diversion canal to the tail-race, was situated parallel to No. 1 penstock and under No. 1 generating unit. Looking at Fig. 1, it will be noted that the centre line of the sluice tube and the centre line of the tail-race coincide, thus providing direct alignment for high velocity flow.

Numerous hydraulic studies were made of the flow in the diversion canal upstream from the sluice tubes, and in the tail-race downstream from the sluice tube, and by means of these studies the heights of the passage-ways were fixed. The roof was so designed that with a discharge of 40,000 cusecs the water surface at the entrance would just make contact with it, while at the outlet the water surface would be several feet below the top of the tube. A hydraulic jump was anticipated, but nothing definite with regard to its position or height could be obtained from the computations. As it was necessary to provide a large concrete beam, 16ft. deep, 12ft. wide and about 50ft. long, about 50ft. downstream from the end of the sluice tube and 13ft. above its top for supporting the columns of the power-house the question was of some importance. A standing wave of any kind at this spot might seriously damage the beam. Consequently a model was built of timber in several sections and installed at the foot of the dam adjacent to the Isle Maligne power-house, immediately below the trash sluice gate, in the autumn of 1928. The model was one-eighteenth full size and was hydraulically similar to the prototype. Its length was sufficient to reproduce about 200ft. of diversion canal, 180ft. of sluice tube, and 300ft. of tail-bay and tail-race.

The cement mortar lining of the model was roughened before it had received its permanent set, in order to reproduce as closely as possible the friction coefficient of the rock, and the sluice tube section was cement mortar lined with a smooth finish, with the exception of one side, which was composed of very heavy plate glass in order that the conditions of flow in the tube might be plainly seen and measurements taken at any point under varying conditions of discharge. At the lower end of the tail-race section a stilling box and measuring weir were installed.

The model results verified the computations with regard to the water levels at the upper and lower end of the sluice tube. In addition, it was proved beyond a doubt that there would be no hydraulic jump in the vicinity of the beam in the power-house wall, except under conditions of very low flow, at which time the jump was small and did not approach the beam. The model also clearly demonstrated that a dividing wall in the tail-race parallel to the canal between units 1 and 2 was essential to prevent an eddy in the tail-bay which would seriously decrease the discharge.

Inside the tube in the prototype the flow was fairly smooth, with slight evidence of surging, except at very low stages, when a back roll occurred. For a distance of about 300ft. from the exit the water was relatively smooth, considering the velocity at which it travelled. From this point downstream it was very turbulent for several hundred feet to a point where it passed through a transition stage somewhat resembling a hydraulic jump and then became fairly smooth.

The sluice tube forms part of the power-house sub-structure and is composed of two water passages separated by a concrete dividing wall 7ft. thick. This wall extends 55ft. upstream from the entrance, tapering to a very thin pier nose made of steel plate. At the downstream end it extends 50ft. past the exit, with a similar type of pier nose. An elevation of this wall may be seen in Fig. 2. The upstream and downstream extremities of the wall were designed to offer a minimum of obstruction to flow.

The sluice tube openings are each controlled by a Stoney gate at the entrance. Each gate is approximately 41ft. high and 21ft. 6in. wide and weighs 72 tons. The gates are suspended from brackets set in the concrete above and operated by a system of sheaves and cables from a double drum winch erected on the deck of the dam, about 200ft. distant. They are held in continuous suspension and may be raised or lowered at a few moments' notice. The bottom of each gate is tapered to a thickness of about 1in. at the downstream face, and satisfactory results are obtained while operating in a semi-closed condition, the vibration being negligible. The water passages are each 39·25ft. high and 20ft. wide at the upper end, tapering to 22·25ft. high and 17·75ft. wide at the exit.

The sloping bottom of the sluice tube is similar in shape to a rollway crest on a dam, the concrete projecting well into the underside of the waternappe. For a discharge of 40,000 cusecs the velocity at the upper end is about 30ft. per second, and at the lower end 50ft. per second. The tube has never run full at the lower end even for discharges of well over 40,000 cusecs. For the latter discharge the upper end seals just at the entrance, but the water surface quickly drops away and at no time has the top of the tube been under hydrostatic pressure.

The Cofferdams and Obelisk.

A cofferdam 800ft. long was built between the river and the diversion canal, lying parallel to them. At the point where this cofferdam formed a foundation for the derrick crib two branches were constructed, one of which extended across the entrance to the diversion canal, while the other extended across the river to the "obelisk" base. The Saguenay River is a very difficult stream to cofferdam, particularly in the vicinity of Chute-a-Caron, as the river channel is comparatively narrow with deep, swift water. The impracticability of constructing the ordinary type of rock-filled timber crib cofferdam in the deep section under such adverse flow conditions led to the use of the "obelisk." This method of final cofferdam closure was based on the assumption that the "obelisk," when overthrown, would act in accordance with the computations of design. In fact, it came to rest within a fraction of an inch of its computed position and practically no cracks in the block were noticeable.

Owing to the unusually low flow during May, there appeared to be a good possibility of tipping the "obelisk" in the latter part of June, which would have made possible the completion of the river section of the dam, with the exception of two blocks. But when everything was ready, flow conditions were such that it was decided to postpone the tipping of the "obelisk" until July. The water level in Lake St. John at that time was near its upper limit, but was being lowered slowly by discharging about 170,000 cusecs. Any further obstruction in the river channel at Chute-a-Caron, such as the "obelisk" in its final position, would have seriously decreased the discharge capacity of the river and thereby increased the length of time required to lower the lake for storage purposes. Sufficient lowering of the lake had been accomplished by July 20th, to ensure a period of about eight days during which the flow could be limited to such an extent that it would not overtop the "obelisk" in its final position, and it was decided to take advantage of this period to tip the "obelisk," erect a trestle thereon, and obtain additional information regarding the river bottom.

The "obelisk" was tipped on July 23rd, 1930. Work was begun immediately on the closure of the openings at the ends of the "obelisk" and the extension of the railway trestle over it to the east shore abutment. Although no attempt was made to seal the cofferdam completely during this period, the leakage was relatively small, which made it possible to extend the main dam toward the river channel a distance of 27½ft. past the previous limit. At the end of eight days the discharge from Lake St. John was increased and the flow allowed to pass over the cofferdam into the river channel.

On September 1st needle beams were installed, as the lake had been drawn down about 3ft., although the inflow was sufficiently above the discharge to allow a working period of not more than fifteen days. It was thought that that period would allow sufficient time to do the necessary excavation in the deep portion of the channel and allow the placing of a full block of concrete 55ft. long in the main dam to an elevation above interference from the water when it would again be turned into the river. About four days were employed sealing the "obelisk," installing secondary cofferdams, a flume and a battery of pumps to dry the river bottom. When this work was completed, excavating on one side of the river bottom and placing concrete in the 55ft. block on the other side were carried on simultaneously. Owing to a seam of poor rock, which entailed the excavation of some thousands of yards, this part of the work was not wholly completed before the water was again turned into the old river channel on September 16th. One block of concrete, however, had been carried above water level and was continued to the top during the remaining part of September.

While the needle beams were being installed and the cofferdam sealed at the beginning of this closure period a low cofferdam was constructed across the river about 400ft. downstream from the main one. The idea was to form a pool from which leakage through the main cofferdam would be handled by a battery of pumps discharging into the diversion canal. Owing to an excessive leakage of about 85 cusecs through a rock seam under the cofferdam lying downstream from the derrick crib, it was found necessary to build a second low cofferdam immediately upstream from the face of the main dam. Thus two pools were formed, the excess flow over pump capacity in the upper pool spilling into the lower. From the lower pool the leakage was carried away by a small timber flume extending across the area of the main dam and discharged at a point several hundred feet downstream.

Immediately afterwards the control gates in the sluice tube were dropped. During the period required for the water in the forebay to rise from elevation 150 to elevation 210 no flow passed down the river below Chute-a-Caron, and the time was utilised to construct a cofferdam in the tail-race a few feet downstream from the throat of the tail-bay. The cofferdam was built to keep the tail-bay dry during the erection of the sub-structure in No. 1 unit, and the extension of the tail-bay weir.

The substructure for No. 1 unit was carried to such a height that it formed a bulkhead at the exit end of the water passages of the sluice tube, and from this point the filling of the sluice tube openings was carried on simultaneously with the concreting operation at No. 1 unit.

When the substructure had been completed to elevation 90, which was 3ft. above normal tail-water, and the downstream face of the No. 1 draught tube sealed by means of the draught tube needle beams, the interesting and very troublesome problems of diversion were things of the past. No combination of conditions with regard to flow could thereafter cause damage or delay, and the structure was carried to completion without further worry from this source.

A series of views showing various stages of the work is reproduced on page 708.

The design and construction of the Chute-a-Caron project was undertaken by the Alcoa Power Company. C. P. Dunn, M.E.I.C., is chief engineer; I. G. Calderwood, general superintendent of construction; I. E. Burks, concrete technician; and G. O. Vogan, who presented the details of the undertaking at the recent annual meeting of the Engineering Institute of Canada, is chief designing engineer.

Books of Reference.

Chamber of Shipping of the United Kingdom, 1930-31 *Annual Report*. London: Witherby and Co.—This volume, though it is largely concerned with the Annual Report of the Council of the Chamber and with the "Proceedings" at the Annual Meeting, contains a considerable amount of information which is of interest to those who do not actually belong to the Chamber, especially to engineers who are in any way connected with shipping. For example, the sections dealing with the prevailing trade depression will, no doubt, be widely read, while the statistical tables and diagrams are of great value, and will certainly be carefully studied by many.

The South African Mining and Engineering Year Book, 1931. London: Argus South African Newspapers, Ltd., 72–78, Fleet-street, E.C. 4. Price £1 1s. net.—The new volume contains some 628 pages of detailed information about the leading engineering concerns and principal industries of South Africa. It is profusely illustrated, and includes maps of the mining fields of the country and portraits of mining, industrial, and financial leaders. It is sectionalised as follows:—Directory, Year Book, Electrical, Industrial, and Mozambique, and will be of much value to all firms having connections in South Africa and those interested in Empire development.

The Directory of Clayworkers, 1931. London: Published at *The British Clayworker* Offices, 43, Essex-street, Strand, W.C. 2. Price 7s. 6d.—The previous issue of this work of reference was published in 1923. The present volume contains a list running to nearly ninety pages of British clayworkers with their addresses. That is followed by a geographical classification in which the firms are arranged under the headings of counties and towns in (*a*) England and Wales; (*b*) Scotland; (*c*) Ireland; and (*f*) the Irish Free State. Then there is a list of trade names and trade marks, and, finally, there is a list, with addresses, of the associations connected with the clay industries.

The Universal Directory of Railway Officials, 1931. London: The London Directory Publishing Company, Ltd., 33, Tothill-street, Westminster, S.W. 1. Price 20s. net.—This most useful book of reference reaches, with its present issue, its thirty-seventh year of publication. As is well known, the information that it contains is compiled from official sources under the direction of the editor of our contemporary the *Railway Gazette*, and is the only single book which brings together within two covers data regarding practically all the railways of the world and the names of their chief officials. We are continually consulting it and have always found the particulars given in it correct and up to date.

The Oil and Petroleum Year Book, 1931. London: W. E. Skinner, 15, Dowgate-hill, E.C. 4. Price 7s. 6d. net.—The new volume is the twenty-second annual issue of what is now recognised as a standard international reference work of the oil industry, and the information contained therein is the latest available to May 21st, 1931. It contains some 450 pages and gives particulars of 620 British and foreign companies—producers, refiners, dealers, carriers, financiers, &c.—with lists of their officials, capital, accounts, location of property, wells, production, &c. There is also a useful trade names list and buyers' guide. The book has for many years proved its value, and the new edition is fully up to the standard set by its predecessors.

Kelly's Directory of the Merchants, Manufacturers, and Shippers of the World. In two volumes. London: Published by Kelly's Directories, Ltd., 186, Strand, W.C. 2. Price 64s. post free.—This exceedingly useful book of reference appears, this year, in its forty-fifth edition, and it is so well known that there is little need for us to write anything in the way of introduction. We can, however, endorse the publishers' claim that, in addition to comprising more than one and a-half million names, and dealing with over twenty thousand places, it is a gazeteer which contains a fund of facts and figures which are of very considerable value to the business man. As usual, the book, which is indexed in four languages—English, French, German, and Spanish—is arranged in two volumes. No. 1 deals with foreign countries and their possessions, while No. 2 is concerned with Great Britain, India, and the British Dominions, Colonies, Protectorates and Dependencies. The British volume is divided into three sections: (1) England, Scotland and Wales; (2) London; and (3) Ireland. Each of these sub-sections is again divided up into the following sub-sections:—(*a*) Alphabetical; (*b*) classified trades; (*c*) telegraphic addresses; (*d*) exporters; and (*e*) importers. The whole of the information has, the publishers assure us, been corrected and brought up to date with scrupulous care, and we do not doubt that the present edition will prove to be every bit as helpful as we have found those that have gone before it.

Transformer Tap Changing on Load.

ALL the on-load transformer tap-changing equipments that have been described on various occasions in our columns have been built in this country. On the Continent induction regulators have been widely employed, but by reason of the increase in transmission pressures and

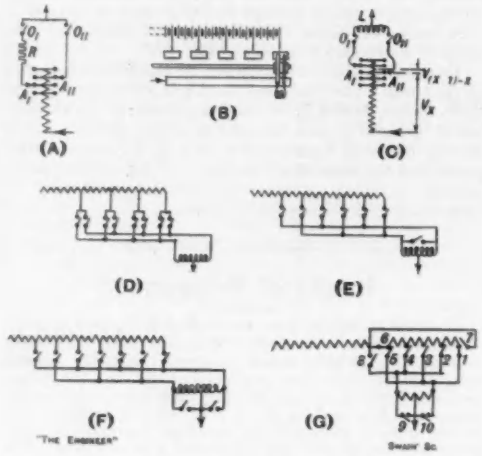


FIG. 1—LOAD TAP CHANGING SCHEMES

the fact that this type of apparatus cannot be directly connected in extra high-pressure circuits, the system of regulating voltage by means of transformers equipped with on-load tap-changing gear has been adopted by continental firms.

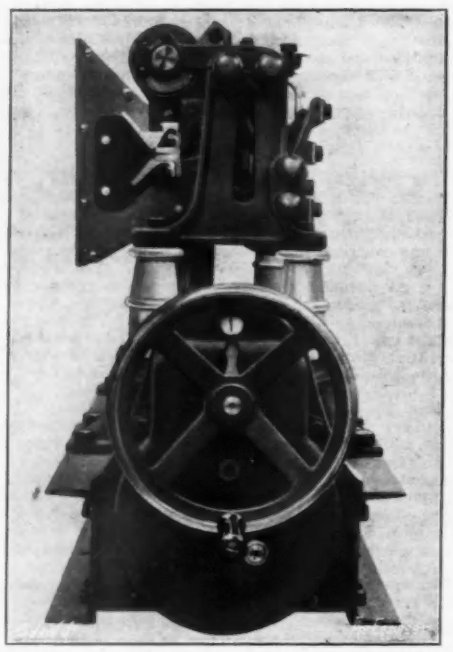


FIG. 2—SIDE VIEW OF AIR BREAK STEP SWITCH

In the opinion of the engineers of the Oerlikon Company, the induction regulator is generally preferable when the voltage does not exceed that generated by alternators, although when the number of pressure steps is small the step switch may be more advantageous. The Oerlikon Company claims that as far back as twenty years ago it built transformer step switches embodying many of the ideas which are now claimed to be new. These step switches were evolved from the well-known battery regulating switch with a resistance to avoid a short circuit when passing from one stud to the next.

The original method of on-load pressure regulation, however, seems to have consisted of switching off transformers working in parallel one after the other by means of their oil circuit breakers, and in altering the number of turns to the extent required by means of "off" load tapping switches, after which the transformers were again connected in parallel. During the short time the transformers were working with unequal voltage ratios, the circulating current was limited to a safe value by the leakage reactance of the transformers. Obviously this scheme constitutes the basis of the parallel winding method of regulation which has been described in THE ENGINEER. Like various other electrical manufacturers, the Oerlikon Company does not favour this method. In common with most firms in this country, it employs the external reactance or choke coil method with which our readers are also familiar. If the impedance in the form of a choking coil or a resistance is inserted between a tapping switch and a corresponding oil circuit breaker, as at A in Fig. 1, the connections resemble those for the battery switch shown at B in Fig. 1. As the bridging coil only carries load during the tap-changing period it is of small dimensions, but in order to obtain a given number of pressure steps the transformer must be provided with a corresponding number of tappings. If, however, a choking coil is arranged, as shown at C in Fig. 1, and the coil is designed for permanent operation as a balancer, when the selector switches are on two consecutive tappings a further step is provided, *i.e.*, the mean pressure between two tappings. If the step pressure is to correspond to the pressure of one tapping, the two tapping switches will be in the same position. Under these conditions the two portions of the choke coil will carry currents, but since they are in the reverse direction they give rise to no magnetisation. The choke coil therefore only gives rise to a negligible voltage drop. The diagram C differs from the diagram A in that it is possible to obtain with the same number of tappings on the transformer twice as many pressure steps as can be obtained with the arrangement shown in the diagram A. With the latter arrangement the passage of the tapping switches A_I and A_{II} from one tapping to the next takes places as in the case of the arrangement shown in the diagram C, only after the local circuit R or L has been interrupted by the corresponding switch O_I or O_{II}. In the meantime the main circuit is, of course, maintained by the switch which remains closed. In the case of the arrangements shown at A and C, circuit breakers for interrupting the circuit are used. The step switches employed, however, are often in the form of contactors which are constructed so that they themselves can interrupt the current. These contactors are operated either individually by electro-magnetic or pneumatic means or through the intermediary of a common shaft, a first arrangement derived directly from C being that shown at D.

It will be seen that for each tapping there are two contactors, and if the desired pressure step is to correspond to one tapping, after the pressure change has been brought about, both contactors associated with the active tapping are closed, whilst the other contactors are, of course, open. The choking coil is therefore bridged over. If, on the other hand, it is desired to have an intermediate pressure between two neighbouring tappings, one contactor is closed on the two neighbouring tappings and then the coil works as a balancer. This arrangement necessitates the use of two contactors per tapping. The coil can, however, be short-circuited by means of a single central contactor, as shown at E, when the number of tappings is reduced to $\frac{n-1}{2}+2$ for n pressure steps. Both in the case of the arrangement shown at D and E, the current which divides into two streams gives rise to a certain ohmic drop and to permanent losses in the positions in which the choking coil is short circuited, but this can be avoided by the use of another contactor, for short circuiting for the time being only half the choking coil, as shown at F. The number of contactors is then $\frac{n-1}{2}+3$ for n pressure steps. In the case of all transformers on which the portion of the winding which carries the tappings is designed as an actual regulating winding distributed over the whole length of the limb, use can be made of a reversing arrangement, as shown at G. The regulating winding is then connected to the main winding in such a way that the pressure produced in it is added to or subtracted from the pressure of the main winding, according to the step pressure required. The number of pressure steps is doubled for the same number of tappings on the transformer. For

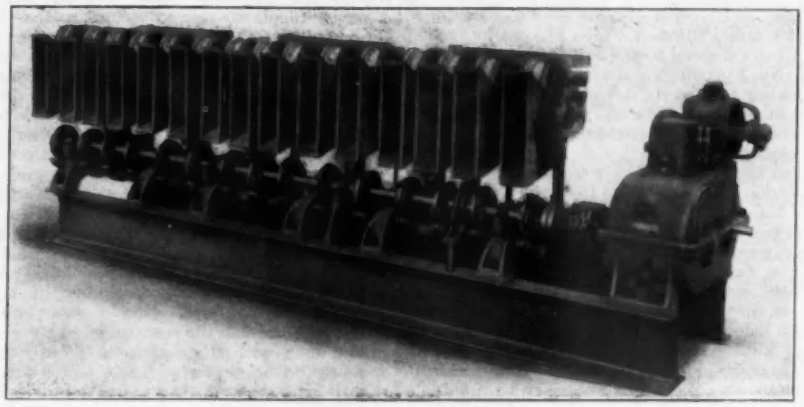


FIG. 5—REMOTE CONTROLLED THREE-PHASE AIR BREAK STEP SWITCH

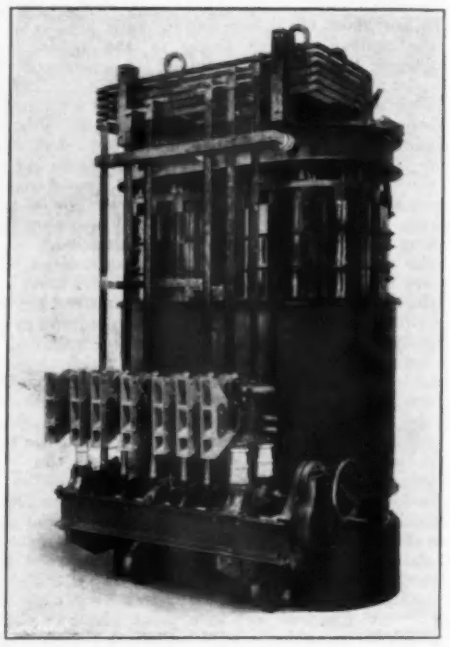


FIG. 6—SINGLE-PHASE TRANSFORMER FITTED WITH STEP SWITCH

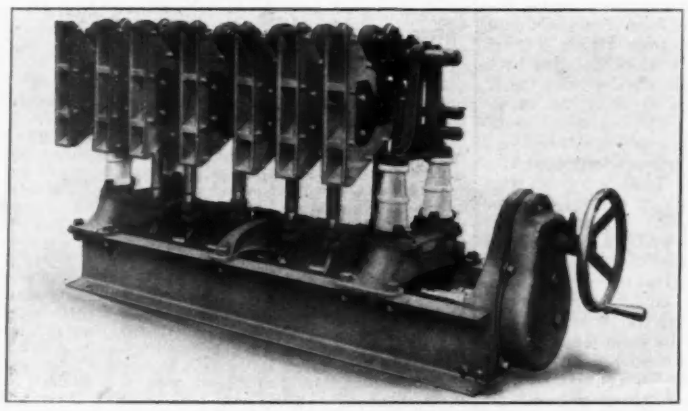


FIG. 3—HAND-OPERATED SINGLE-PHASE AIR BREAK STEP SWITCH

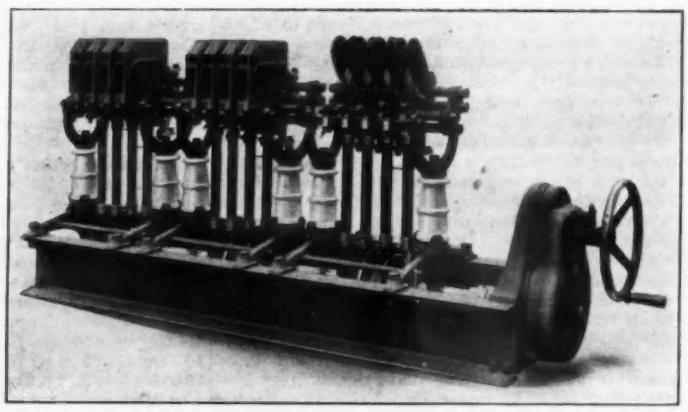


FIG. 4—HAND-OPERATED THREE-PHASE AIR BREAK STEP SWITCH

n pressure steps—positions of step switch—it is necessary to have $\frac{n-1}{4}+6$ contactors for $\frac{n-1}{4}+2$ tappings on the transformer.

With a view to meeting the demand for step switches for pressure regulation on load, the Oerlikon Company has utilised its experience gained in connection with traction gear, and has evolved various types of apparatus. When the transformer pressures are low and the step pressures moderate, and when the gear is for indoor use, the step switch may be of the air-break type, as shown in Figs. 2–5. The illustration, Fig. 2, gives a side view of the step switch shown in Fig. 3, which illustrates a hand-operated single-phase air-break step switch for a transformer for use in connection with electric furnaces, the transformer being rated at 4130 kVA, 10,000 volts, 50 cycles, and having ten 7 per cent. voltage steps. The air-break switch shown in Fig. 4 is a three-phase hand-operated air-break step switch for a 1500 kVA, 9500-volt, 50-cycle transformer, and in this case there are four steps each of 2·6 per cent. The switch shown in Fig. 5, which is also of the air-break type, is designed for remote control and is for use in conjunction with a three-phase, 7000-kVA transformer. In this case there are five 2·2 per cent. steps.

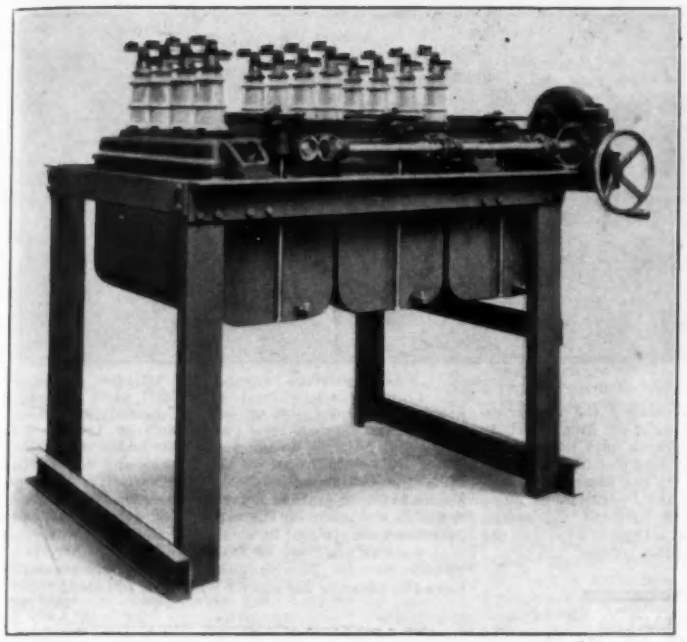


FIG. 7—HAND-OPERATED THREE-PHASE OIL-IMMERSED STEP SWITCH

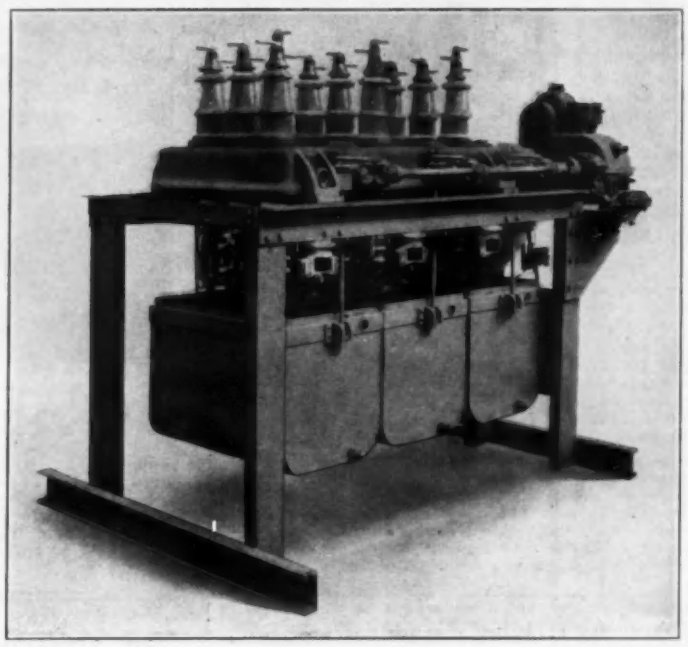


FIG. 8—REMOTE CONTROLLED THREE-PHASE OIL-IMMERSED STEP SWITCH

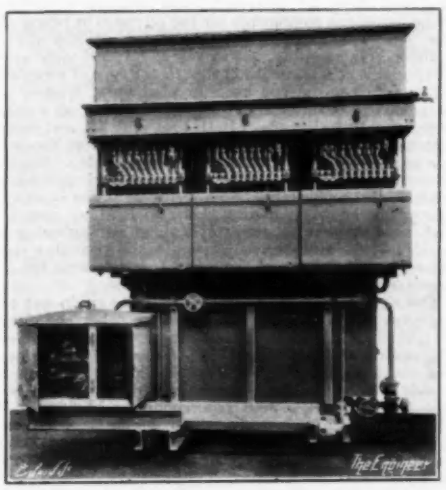


FIG. 9—THREE-PHASE TRANSFORMER WITH STEP SWITCHES

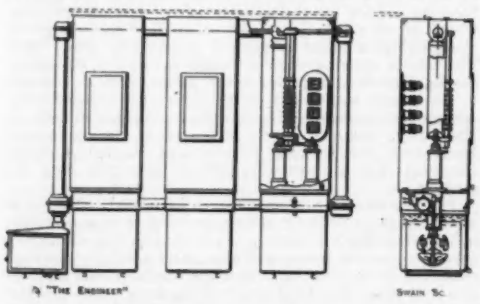


FIG. 10—ARRANGEMENT OF STEP SWITCHES ON TRANSFORMER

The contacts of these switches are in the form of strong fingers, or blocks, and the upper contact is fixed, while the lower contact is fitted to a lever through the intermediary of springs, the lever being operated from the common shaft through the intermediary of cams, levers with rollers and insulating rods arranged in a vertical plane, and the switch is opened by springs assisted by the weight of the rods. If, for any reason, a contactor should not be opened by these springs, it is thrown open by special projections on the cams as the operating spindle continues to revolve. In addition to the main motion about the centre point of the lever, the main contact is given an additional movement which ensures that the contact surfaces move over each other so as to ensure that the passage of current does not take place at the same place every time the circuit is broken.

In Fig. 2 the arc chute of the first contactor has been removed in order that the contacts with their arcing horns may be seen. The blow-out coil is secured above the contacts and carries the removable arc chute. In the case of hand-operated equipment, the switch is actuated by a hand wheel through gears, and as will be gathered from Fig. 2, an indicator is provided to show which transformer tapping is in use. A 4150 kVA, single-phase transformer for feeding electric furnaces and fitted with air-break tapping switches is shown in Fig. 6. In the case of high step pressures and high step outputs the step switches are immersed in oil, but the contact gear remains the same, although the blow-out coils and arc chutes are, of course, dispensed with. From Figs. 7 and 8 it will be perceived that the base of the switches is formed by the oil tank cover, which is common to all three phases. The illustration, Fig. 7, shows a three-phase, oil-immersed, tap-changing equipment for a 10,000 kVA, 11,000-volt, 50-cycle transformer, with $\pm$ eight steps each for 1·1 per cent. and provided with hand-operating gear, whilst Fig. 8 shows an oil-immersed equipment for a 13,500 kVA, three-phase 28,000-volt, 50-cycle transformer. In this case the switches are operated on the remote control system, and there are eight 1 per cent. steps.

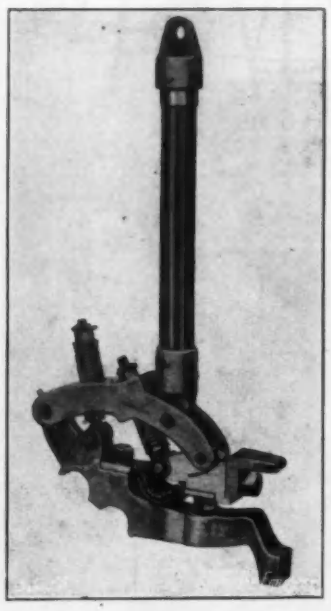


FIG. 11—CONTACT UNIT

In the case of outdoor operation, the step switches, like the corresponding transformer, must, of course, be of the oil-immersed type, and Fig. 9 is considered to be a very suitable arrangement. This illustration shows a 8000 kVA, three-phase, 16,500-volt regulating transformer, combined with oil-immersed switches for ten $\pm$ 1 per cent. steps, the regulating gear being actuated on the remote control system. The oil tanks for the tapping switches are shown in the lowered position, the arrangement being such that each tank can be lowered independently. The connections from the transformer to the step switches are run in an oil-filled prismatic container above the step switch container cover, and serves as an oil expansion vessel for the transformer. The bridging coil is inside the transformer tank and the transformer itself is secured to the cover, and when the transformer is lifted from the tank the bridging coil and step switches are raised at the same time. When the cover of the oil expansion vessel is removed the connections between the transformer and step switches are exposed. The remote control equipment is arranged in a water-tight casing and the position of the step switch is indicated outside. For the purpose of operating the gear by hand a handle is provided, and, in order to prevent the simultaneous operation of the remote control equipment when the hand gear is utilised, the control circuit is automatically interrupted.

The illustration, Fig. 11, shows the moving part of a contactor unit, with the operating rod composed of insulating material. In the case of pressures from 50,000 volts and upwards, the switching equipment is divided into two parts, as shown at C in Fig. 1, where there is a tapping switch for operation with the current cut off and also circuit breakers. There are two separate tanks for each phase. The upper tank—see Fig. 10—is mounted on the transformer, and contains the tapping or selector switch, which is of the drum type, the drum being composed of an insulated tube—see Fig. 12. The upper part provides the insulation between the switch and operating gear, and in order to dispense with insulation at the other end the drum is fitted to one of the bushings leading to the circuit

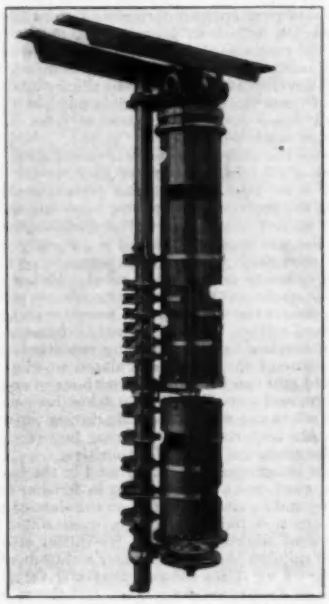


FIG. 12—SELECTOR SWITCH

breaker, which is arranged below the tapping switch, so that the base of the latter constitutes its cover. The tapping switches are of very substantial construction, and are claimed to be very reliable, whilst all the parts are accessible. The tanks containing the circuit breakers—

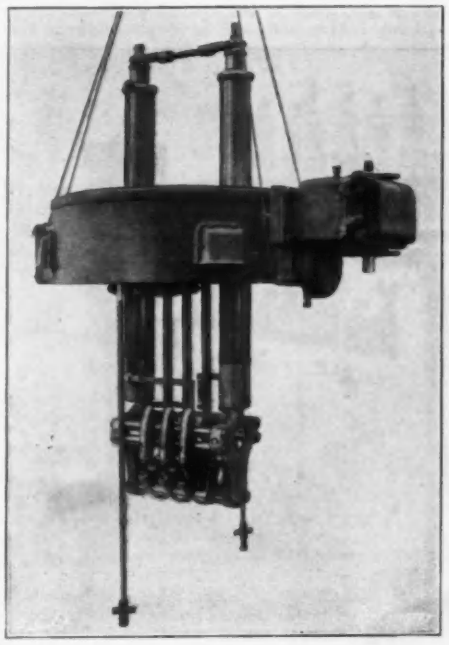


FIG. 13—62-KV CIRCUIT BREAKER

shown in Fig. 13—are lowered by means of spindles operated by means of handles, as in the case of ordinary oil circuit breakers, and when the tanks have been lowered the contacts are exposed.

Auto-Frettage Gun Construction.

IN a paper which appears in the *Journal* of the Faculty of Engineering, Tokyo Imperial University, Tokyo, Japan, Vol. XIX., No. 6, problems connected with gun construction by auto-frettage are discussed and solved from a practical point of view by Mr. S. Sasaki. The introduction to the paper runs as follows:—

Since the war a new method of gun construction, *i.e.*, one-piece gun construction by means of auto-frettage, has drawn the attention of several authorities, and is said to be one of the epoch-making events in the art of gun construction. For the benefit of those who are not familiar with the matter, it will be convenient to explain it briefly here. If a gun is expanded by internal fluid pressure until the most parts of metal are stressed beyond the elastic limit, the inner layers are permanently deformed more than the outer layers. Then on removal of the pressure such a distribution of permanent deformations gives to the gun a proper hooping effect to increase its elastic strength. Although the fundamental idea can at least be dated back to the beginning of this century, yet its realisation belongs to a recent development; so that the theory relating to the strength of guns thus constructed is not yet fully developed, and many problems important from a practical point of view are left untouched.

In practice the internal pressure is raised until the outermost fibres of a forging are stressed just beyond the elastic limit and then released. If the circumferential compression at the innermost layer after removing the pressure does not exceed the compressive elastic limit of the material, the gun thus constructed is generally considered to stand elastically the internal pressure equal to the maximum pressure previously applied. Hence the existing theories on the auto-frettaged gun mainly relate to the relation between the auto-frettage pressure and the depth of the semi-elastic or permanently deformed region. Several authorities have made many contributions to this subject; some of them have calculated to what extent a thick-walled gun can be expanded without over-compressing the bore, and some others have taken into account the hardening effect due to cold working during the expanding process. An important fact seems, however, to have escaped the attention of these authorities.

Professor Bauschinger already found in the last century that when steel was strained either in tension or in compression beyond its elastic limit, then the elastic limit in the opposite direction reduced to zero, even when the cold-working stress slightly exceeded its initial elastic limit. It is to be noticed that Bauschinger's statement is often misunderstood as if he showed that the total range of perfect elasticity remained constant and the elastic limits were only shifted by overstraining. The author, however, has experimentally confirmed that Bauschinger's statement holds good with a certain gun steel. So that in cycles which are to be expected at the bore of the gun, hysteresis loops would be formed if stress and strain measurements could be obtained and plotted.

In view of this fact it may easily be inferred that an auto-frettaged gun manufactured in the ordinary manner may stand without rupture the internal pressure equal to the maximum pressure previously applied, but metals of inner layers unavoidably undergo overstrain on each application and removal of the pressure. In consequence a small part of the firing energy will be wasted as hysteresis loss and will result in a decrease of the muzzle velocity.

As W. Blandy has noted, another consequence of over-expanding a thick-walled gun is that the metal may be enabled by its own inertia to withstand the over-compression at the bore, until the shock of the first few shots destroys this inertia, causes a collapse, and necessitates re-boring the gun. As a matter of fact this defect can be removed by ageing or tempering the gun after the expansion, but the excess pressure in the operation of auto-frettage is not fully available to increase the elastic strength of the gun. Therefore, in a thick-walled gun the expansion is to be limited to a certain extent.

An Artesian Well in Bucks.

IN our issue of May 16th, 1930, we described a remarkable artesian well which had been sunk at Slough, Buckinghamshire, for the water supply of a local factory, and gave the astonishing flow of 6,000,000 gallons a day. This well has now a neighbour, though of smaller output, which is also of the true artesian type. That is to say, the water flows from its mouth without any pumping.

This new bore-hole has been put down for the Grand Union Canal Company by Le Grand, Sutcliff and Gell,

ARTESIAN WELL AT SLOUGH

Ltd., of Southall, Middlesex, to supply feed water to the canal at Slough. It is 1033ft. deep and penetrates the lower greensand, where the hydraulic pressure is sufficient to bring the water to the surface. The casing is 8in. in diameter. After passing through the surface soil and some clay, chalk was met at a depth of 327ft., and persisted in some form or another to 853ft. There were then several strata of gault and the greensand was met at 1016ft. The bore was continued for another 16ft. into the greensand, when a flow of half a million gallons per twenty-four hours and a pressure of 40 lb. per square inch were obtained. When flowing freely the water spouts up to a height of about 6ft., as shown in our engraving, and there is every indication that a much larger flow could be obtained. In order to control the flow of water, the top of the casing has been equipped with a tee piece fitted with two gate valves. The top valve permits the insertion of the rods for drilling, while the side valve is used to regulate the discharge to the canal.

The boring was started during the latter part of last year, and was finished in March. These wells, which reach the greensand, should not, of course, be confused with the bores in the London basin, which only go down into the chalk and have to be pumped. The latter receive their water by precipitation on the Downs and the Chiltern Hills and the slowness of the percolation of the water accounts for its gradual lowering under London as greater demands are made on the supply. The deep wells in the greensand are claimed by some to receive their water from high land as far away as France and the porosity of the stratum permits the accumulation of sufficient pressure to force the water to the surface when it is released.

WESTLAND-HILL PTERODACTYL

WESTLAND AIRCRAFT WORKS, YEOVIL, MAKERS

The Westland-Hill Pterodactyl Mark IV. Aeroplane.

THE latest development of the Westland-Hill Pterodactyl tailless aeroplane is the Mark IV. three-seater cabin machine, fitted with a De Havilland Gipsy III. engine, which is illustrated above. The primary object of the design is the attainment of a higher degree of safety, comfort and performance than is possible with the conventional type of aircraft. The two characteristics of the aeroplane responsible for the advance in safety are, first, the wing shape and disposition of the control surfaces, and, secondly, the excellent forward view which is impossible of attainment in the tractor type of aeroplane.

The wings are swept back in plan view, washed out in incidence towards the wing-tip, and set at a small negative dihedral angle. Both fore and aft and lateral control is obtained by means of controllers at the wing tips capable of moving to large negative angles. Steering is effected by the use of single-acting vertical wing tip rudders used separately. A powerful air brake is brought into operation when gliding down to land by operating both rudders simultaneously. Stalling and spinning are avoided by the high degree of lateral stability at slow speed inherent in the shape of the wing, together with the efficiency of the controls in all three directions.

The situation of the engine behind the cabin not only improves the pilot's view, but has two other advantages of particular value in a passenger-carrying aeroplane. The engine and propeller noise in the cabin is reduced, and the irregular slapping of the slip-stream from the tractor airscrew over the whole surface of the body disappears entirely, with corresponding benefit to the comfort of the passengers. The engine is completely cowled in and the cooling air is sucked through a specially designed duct by the propeller, which works close to the duct exit.

Not the least interesting of the many novel features of the Pterodactyl is the gear for sweeping the wings forwards or backwards on the ground or in flight. By this means the aeroplane can be trimmed for wide variations in load at all speeds. The undercarriage is of the tandem wheel type developed on an earlier type of Pterodactyl. The wheels are mounted on a rocking frame, which allows of easy riding on bumpy ground, and which has a check to limit the rocking motion. There is claimed to be no chance of the machine overturning in the event of the wheels becoming bogged in soft ground. Steering on the ground is effected by turning the front wheel as on a bicycle, while, to obviate any danger of overturning, a brake is applied to the rear wheel only. The whole undercarriage is faired in with a streamline casing, and from a performance point of view is stated to be nearly equivalent to a retractable undercarriage without, however, suffering from its mechanical difficulties. The body, although short, is roomy in the cabin, and lends itself well to good streamlining, in that it avoids the skin friction normally present over the long tail portion.

The sacrifice in performance, it is argued, which is so often the price paid for safety or comfort is unnecessary in the Pterodactyl. Safety is inherent in the stable properties of a low resistance wing, and comfort and high performance are obtained from the carefully chosen shape of a well-streamlined yet commodious body. The machine is to be flown at the Royal Air Force Display to be held at Hendon to-morrow (Saturday).

IT is said that the lignite deposits of the Onakawana district of Northern Ontario amount to some 125 million tons, and that they are covered with only a thin layer of overburden. A sum of 150,000 dollars is to be expended on exploring the deposits, which are close to the Temiskaming and Northern Railway.

Railway and Road Matters.

AT the end of 1927 the London, Midland and Scottish had a staff of 264,066; at the end of 1930 the number was 233,000. The reduction is not, however, the result of wholesale dismissals because of reduced traffic, but is attributed to adjustments made mainly as a consequence of steady general reorganisation and improvements of a permanent character.

THE new Railway Board for the State-owned and State-operated railways of New Zealand, mentioned herein on May 15th last, is now in office. Mr. H. H. Sterling, the present general manager, retires from that position in September, and will then become Chairman of the Board. The Prime Minister of New Zealand explains that the Board will try to work the railways on business principles, and give an efficient and economical service so as to reduce, if possible, the deficits borne by the taxpayer.

EMULATING the desire of the neighbouring city of Manchester, Liverpool is considering a proposal for constructing a tube railway to link up the three railway termini at Lime-street, Central, and Exchange, and giving communication with the new road tunnel under the Mersey. In this relation it may be recalled that, in connection with the authorised electrification of the Wirral section of the L.M.S. Railway, it is hoped to have electrically operated trains running to and from the Wirral Peninsula through the Mersey Railway tunnel. The bridging of the Dee would further save a detour of 30 miles for railway and road traffic to North Wales.

THE coroner's jury who inquired into the four deaths that occurred as a result of the Beddingham level crossing disaster on the eve of Whit-Sunday, recommended that a warning sign should be erected at the approach to level crossings. That inspired a question in the House of Commons on June 9th as to whether the Minister of Transport would suggest to the railway companies that they should display at some distance from each level crossing a night-illuminated sign which would, under any circumstances, attract the attention of motorists. Mr. Parkinson, in reply, said that the erection of such signs was a matter for the appropriate highway authority rather than for the railway company.

THE Ministry of Transport railway statistics for March gave also the results of the working for the first three months of the year, as compared with the corresponding period of 1930. They show a decrease of 5·9 per cent. in the number of passenger journeys, and of 7·3 per cent. in the receipts from passengers. Passenger traffic receipts from all sources fell by 6·0 per cent. Passenger train mileage was, however, reduced by 1·0 per cent. Freight traffic suffered a decrease of 16·9 per cent. in tonnage, of which 15·1 per cent. was in merchandise and the same proportion was in coal, coke and patent fuel. The freight traffic receipts decreased by 11·8 per cent., of which 11·7 per cent. came from merchandise and 8·0 per cent. from coal, coke and patent fuel. The freight train mileage was reduced by 8·4 per cent.

IT was mentioned herein on May 29th that meetings of the Irish railway companies and of their men had voluntarily agreed to certain reductions in salaries and wages, but that at a delegate meeting on May 12th the men's representatives rejected the proposals. The Irish Railway Wages Board then took the matter in hand, and on June 8th an award was issued on the same terms as those in the voluntary agreement. The representative of the National Union of Railwaymen did not, however, sign it. The situation was saved, though, on June 18th, when the National Union had a conference in Dublin. At the conclusion, Mr. C. T. Cramp, general secretary, announced that, by a majority, the conference had decided to accept the findings of the Wages Board as a final concession by the staffs to the railway companies. He added that this decision had been taken as a last resort to ensure peace on the Irish railways.

RECENTLY, Sir Philip Dawson asked the Minister of Transport what steps he intended to take in respect of the electrification of the railways, having regard to the view taken by the Weir Committee as to the amount of work which would be provided by it and the beneficial effect it would have on the distribution and the cost of electricity throughout the country; and whether he would take steps to induce the railway companies to take in hand immediately the electrification of the suburban services round our great cities and more especially round London, in view of the fact that the Royal Commission on Transport in 1905 recommended that course, and having regard to the success of the Southern Railway. Mr. Parkinson, Under-Secretary to the Ministry of Transport, said that the Minister had asked the principal railway companies to consider the report and to furnish him with their observations upon it as soon as they could It would be remembered that the commercial success likely to result in certain circumstances from carrying out schemes of suburban electrification was one of the matters to which the report referred.

THE Railway Rates Tribunal's review of the standard and exceptional charges of the four grouped companies was issued, as a Stationery Office publication, price 2s., on June 11th. It expresses the opinion that it behoves the companies to walk warily in extending investments in exercise of their road powers, as no doubt they will. They found that, compared with the standard revenue allowed under the Act of 1921, there was a substantial deficiency in the case of each company, but that such deficiencies are not due—quoting the Act—"to lack of efficiency or economy in the management." The coal, iron and steel trades had suggested a decrease of the charges on the ground that it will aid them and, consequently, the railways in earning the standard revenues. The companies, in reply, said that a small reduction would probably have no effect and that whilst a substantial general reduction might have some effect, it would still not stimulate traffic to the extent of making good the loss of revenue on it. The Court found, on that issue, that, under present conditions, no modification would enable the companies to earn their respective standard revenue, and so no modification would be made.

Notes and Memoranda.

THE Safety in Mines Research Board Paper No. 56, published in December, 1929, described a laboratory method of testing the relative inflammability of the dusts of different coals, by measuring the amount of inert dust required to suppress inflammation when small quantities of the particular coal dust which it was desired to test were blown by oxygen through a heated tube. A simplified form of this test, suitable for use in colliery laboratories for testing the inflammability of the dust mixture on the roadways, has now been devised, which reduces the possible personal error to the minimum. At present this test cannot be used in substitution for the officially prescribed test for representative samples of road dust, but it provides a simple means whereby colliery managements can obtain valuable additional information. The apparatus and the method of carrying out the modified test are described, with photographs and a diagram, in S.M.R.B. Paper No. 68, by A. L. Godbert, just published by the Stationery Office, at 6d. net.

THE extensive corrosion which has occurred on some sections of the pipe lines used by the oil companies of the United States has led to the co-operation of the companies and the Bureau of Standards in an investigation of its causes. Nine pipe lines between the Gulf of Mexico and Kansas have been examined, and it has been found that every line has electric currents flowing along it, generated by differences in the states of the metal and of the soil where they come into contact. These currents are found to flow into the pipe from the soil where the soil has a high electrical resistivity, and out of the pipe into the soil where the soil has a low resistivity. The corrosion occurs where the electric current flows out of the pipe into the soil; that is, at points where the resistivity of the soil is low, and at such places the pipes should be suitably coated. The Bureau has produced a simple apparatus for measuring soil resistivity, which consists of two sticks shod with iron cones connected by wires in the axes of the sticks through a milliammeter to two dry cells. The sticks, which are about the size of walking-sticks, are thrust into the ground about 20 cm. apart, and the current read. From the current and the constant of the apparatus, the resistivity of the soil is calculated.

IN a paper on "Modern Developments in Ship Design," by Dr. J. Tutin and A. C. Hardy, contributed to the January number of the *Transactions* of the Institute of Marine Engineers, the authors state that marine growths cannot in general attach themselves to hard surfaces, such as glass, porcelain, and clean steel. Is it too much, therefore, they asked, to expect modern chemical research to provide an anti-corrosive composition with an ultra-hard surface? In a written communication, contained in the *Transactions*, P. Jenkins, chief chemist to J. Dampney and Co., Ltd., stated that he thought the theory that marine growths do not adhere to hard surfaces is doubtful; in the Hancock Museum, Newcastle, is a bottle encrusted with beautiful specimens of barnacles. All paints and compositions have, of necessity, to contain oily matter to repel water, and such materials cannot be made very hard. It is, therefore, too much to expect chemical research to find an ultra-hard preservative for ships' hulls. The only coating of this nature which can be applied to iron is vitreous enamel, and that is impracticable for the protection of ships. Vitreous enamels are fused at high temperatures and are applicable to only relatively small objects. They are also prone to chip off.

THE Aeronautics Branch of the U.S. Department of Commerce is working on the development of a wireless supplement to the automatic telegraph-typewriter system used on airways in transmitting weather information to the various stations along a line of flight. During recent initial tests, wireless typewriter transmitters and receivers were installed at the Department of Commerce airway radio stations at Buffalo, N.Y., and Bellefonte, Pa., and automatic two-way communication was maintained by means of them. The hourly weather messages which were being sent over the Cleveland-New York airway were received by the automatic telegraph transmitter on the airway circuit at Bellefonte, and transmitted through automatic telegraph-typewriter machines. The signals were received at Buffalo, the impulses operating an automatic telegraph-typewriter which reduced the messages to typewritten records on tape. The messages as finally received by the machine at Buffalo were in the same form as that in which they had originally been received on the airway wire circuit at Bellefonte before being transmitted by wireless. The operation of the system is such that any airway station along the Cleveland-New York circuit may operate the transmitting set at Bellefonte, as the messages which go over the circuit from any of those stations may be automatically received by any wireless typewriter receiver within range of the station.

THE production of porous ebonite for use as a filtration material was, says the *Chemical Trade Journal*, described by E. Vossen, Cologne, recently in a paper to the annual meeting of the Deutsche Gesellschaft für Chemisches Apparatewesen E.V., held in Vienna. According to this authority the ebonite should be completely vulcanised—that is, should contain 32·08 per cent. of combined sulphur on the weight of the rubber. A preliminary vulcanisation is not carried past the point at which the material can be powdered in a grinding mill. After grinding, the powder is put into pre-warmed iron moulds and the vulcanisation completed under pressure. It is stated that products with porosities of 30, 40, 50 and 60 per cent.—calculated as the percentage of air per unit volume of material—had been obtained, whilst materials having a fineness down to a thousand pores per square centimetre had been produced. Investigations are still under way to see whether still finer products, for use in bacterial and colloidal filtration, can be obtained. The ebonite produced is completely resistant towards hydrofluoric, hydrochloric, sulphurous, phosphoric and phosphorous acids, and also to alkalis and salt solutions. For 70 per cent. sulphuric acid it is serviceable up to temperatures of 70 deg. Cent., and for 20 per cent. nitric acid to 20 deg. Cent. The general properties of ebonite, of course, limit its utility to a temperature range of minus 10 deg. Cent. to plus 110 deg. Cent.

Miscellanea.

THERE is to be a special section for cycles and motor cycles at the British Industries Fair, Birmingham, next year.

THE large-scale production of solid carbon dioxide for refrigerating purposes is about to be started at Billingham.

THE price of mercury has been reduced from £21 15s. per 76 lb. flask, at which it has stood for some years, to £17 per flask.

THE annual local production of nails in South Africa is estimated at the value of £20,000, while importations amount to £70,000.

THE Gatineau Power Company claims a record in having produced during one day recently 9,102,120 kilowatt-hours of electric energy.

IT is reported that 500 kilos. of synthetic rubber have been produced, experimentally, in Leningrad, with alcohol as the raw material.

IT is said that the tungsten ore deposits of Gordonia, South Africa, contain over 70 per cent. of tungstic oxide and less than 0·2 per cent. of tin. The veins have been traced for a distance of at least 9 miles.

A LAYOUT of tramway track work for the Leeds Corporation, which has recently been made by Edgar Allen and Co., of Sheffield, contains 46 tons of manganese steel. It is the turnout for the new depôt at Swinegate and has fifteen branches. The largest castings weigh 12 cwt. and there are, in all, 1415ft. of rail in the assembly.

THE Suez Canal Company has given an order to the Société Provençale de Constructions Navales for an electrically-propelled ferry boat to run between Port Said and Port Fuad. This boat, which will be moored at the end of the quays, will not have to turn round at the end of each journey, as it is to be shaped and equipped to run with either end in front. It will carry over 400 passengers and six motor or other vehicles.

ACCORDING to figures published by the Dominion Bureau of Statistics at Ottawa, the production of pig iron in Canada last year totalled 747,178 long tons, as compared with 1,080,160 tons in 1929, 1,037,727 tons in 1928, and 709,697 tons in 1927. Imports of pig iron during 1930 amounted to 13,643 tons, a decline of 58·1 per cent. from the total of 32,548 tons brought in during 1929. Exports were reported at 593 long tons, as compared with 7478 tons in the previous year.

IT is now possible for a party of aerial travellers to hire a four-passenger flying limousine from Imperial Airways at a cost, per passenger, of not more than 6d. a mile. A party of a dozen tourists, hiring one of the 12-seater Handley Page-Napier air liners, can make a flying pleasure trip at a cost per passenger, of not more than 5d. a mile; while a big "Silver Wing" aircraft, accommodating 20 passengers, can be chartered for aerial tours at rates which do not work out at more than 4½d. per traveller per mile.

THE direction of the magnetic compass needle at any place changes from year to year. As a great many of the old land boundaries in Canada were surveyed by compass needle, when it is now required to retrace such an old lost land boundary it is necessary to know how much the needle has changed its direction since the old survey was made. Such information for very many places in Canada and reaching as far back as 1750, has been compiled and published in bulletin form by the Topographical Survey, Department of the Interior.

A FEW days ago the Earl of Derby opened the new Corporation gasworks at Mossley. The enterprise is one of considerable importance to the town and to the somewhat extensive area to which the gas supply will extend, and the cost will be approximately £130,000. The district supplied includes, besides Mossley, a portion of Springhead, Greenfield, Uppermill, Dobeross, Diggle, Delph and Denshaw, the six last named forming the urban district of Saddleworth. The greater part of the area consists of moorland, rising to a height of nearly 2000ft. While it is impossible to supply gas to the whole area, it is supplied to consumers at a level of more than 1000ft. above the sea. The gas is delivered to points 7½ miles from the works in the Saddleworth area, and 2½ miles in the Mossley area.

THE forgotten art of flint walling, states the *Builder*, was recently described by a veteran bricklayer, Mr. Arthur Crane. He started work soon after the Franco-Prussian War in 1871, and was employed on the construction of the many flint cottages which may be seen in Sussex to-day on the Duke of Richmond's estate near Goodwood. Flint laying is divided into two classes, smooth and random work, and the secret of success is symmetry of pattern and the perfect straightness of the joints. The flints in the old days were picked up either on the sea shore or in the fields. Fifty years ago Mr. Crane reckoned on building a square a hundred feet long by 1ft. high in a ten-hour day. In an interview, he added: "We used to fill in the middle solidly, not tip it in with a bushel basket, like they do now. It was all piecework and I had to work pretty hard to get 6s. 8d. a day."

ONE of the latest hand micro telephones, finished in old gold, has just been accepted by the King for use in Buckingham Palace. It bears a decorative plate, surmounted by a crown, and is inscribed: "This instrument, installed for His Majesty King George V., is the 2,000,000th telephone connected with the Post Office system, June, 1931." During the past few years the British telephone service has grown at a rate averaging 125,000 telephones a year. Two out of three of the orders now being taken are for telephones in the home. There are now 35,000 call boxes all over the country, including over 10,500 situated in rural districts. Special attention is being paid to the development of the telephone service in country districts, where it is of particular value in reducing the disadvantages of isolation. Rural telephone exchanges to-day number 3300, and that total is growing at a rate of 200 exchanges yearly. The Post Office is launching a campaign in the hope of persuading the general public to look upon the telephone as a household requisite and not merely a business machine.

DIVERSION WORKS AT CHUTE-A-CARON ON THE SAGUENAY RIVER, QUEBEC

(For description see page 702)

VIEW DOWNSTREAM SHOWING PARTIALLY COMPLETED COFFERDAM WORKS

TIPPING "OBELISK" INTO MAIN CHANNEL OF RIVER

VIEW SHOWING TAIL-RACE TEMPORARILY USED AS DIVERSION CHANNEL

VIEW OF DAM LOOKING DOWNSTREAM

The Engineer

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The Metallurgist.

THE JUNE NUMBER OF THE MONTHLY METALLURGICAL SUPPLEMENT TO "THE ENGINEER" ACCOMPANIES THIS ISSUE.

THE ENGINEER.

VOL. CLI No. 3937

JUNE 26, 1931.

Meeting the Market.

AMONGST the papers discussed this week at the Advertising Convention in Glasgow there were two of especial interest to engineers. One, by Mr. Sam Mavor, discusses the problems of distribution from the manufacturer's point of view with the calmness of long experience and complete knowledge of the niceties and difficulties of salesmanship in a particular field; the other, by Sir Francis Goodenough, is a burning condemnation of a *laisser faire* policy in the handling of markets, and what, if we may be tempted to break down our customary restraint, we should describe as a "clarion call" to manufacturers to organise sales campaigns. "Nothing," exclaimed Sir Francis, "has struck me more during the past two to three years in my investigation of evidence of many kinds from many parts of the world, of the marketing shortcomings of some of our traders, nothing has struck me more than the lack of thorough, detailed, organised exploration of the needs, habits, tastes and fancies of the customers in the multifarious markets of the world . . . followed by the production of goods and services, and the organisation of skilled marketing forces, accurately designed to secure those inhabitants as customers and to please, satisfy and retain them." And again, "I suggest that it is time that—not here and there, not as brilliant exception, such as some of our leading business houses present—but everywhere as a natural habit, national policy, and national pride, we should cease, once and for all, to rely on 'muddling through,' and should set about thinking through, planning through, working through—and so, surely and truly and deservedly, winning through."

Anyone who has studied the reports of the Committee on Salesmanship will recognise in the passages we have just quoted the style of its energetic and intrepid Chairman. He has consistently given sound advice, and we have no doubt that, in the end, it will have a good effect. But it must be admitted that a great salesman—as we venture to call Sir Francis—views the problems of the market from a different standpoint than that of the manufacturer. Hence it is that the two papers to which we have alluded are complementary to each other, for whilst Sir Francis sees only the necessity for getting sales, Mr. Mavor knows the difficulties which the manufacturer has to face. Let us take the all too common charge that British manufacturers fail to study the requirements of the market. Great Britain is not the only nation that has to suffer continually this form of criticism; every other manufacturing nation of the world is told the same thing by its trade commissions and consuls. That fact, alone, shows that there must be some good reason behind what appears sometimes to the critic as mere blockheadedness. Consider the following passage from Mr. Sam Mavor's address: "British manufacturing engineers are often blamed for inflexibility in adapting their products to the requirements of individual markets and individual users. There is some warrant for this charge, but there is another side to the question. When an engineer who markets a highly specialised machine which embodies the results of lifelong intensive study, and every component of which has been evolved by research and experience and use, is confronted with demands prompted by inexperience, for modifications of kinds that long since were abandoned as unsatisfactory—to what extent should the manufacturer comply, knowing that the proposed alterations will definitely degrade the quality and impair the functioning of his machine?" That is, indeed, a difficult question. It places the manufacturer on the horns of a dilemma. On the one hand he desires to secure the market, and on the other wishes to maintain a reputation built up by years of hard-won experience. The salesman might have no doubt about the course to pursue, but the engineer who took a pride in his products could hardly be expected to give way without a struggle. It is true that a great deal of engineering is nowadays just manufacturing and nothing more; but it is equally true that in some the feeling of the artist still prevails. There is pride in the design, in the results, in the workmanship. Between the two there is almost the same difference as that between a builder turning out half a mile of paltry villas and the architect designing a single beautiful house. Hence, whilst we can comprehend Sir Francis Goodenough's desire to get the market almost at any cost we cannot withhold our sympathy from Mr. Mavor, who, as an engineer, wishes to give of his best and what he believes will be the best for his customer. "Sometimes," he said, "it is bad policy to make for a purchaser what he desires, and is willing to pay for. It is part of service to a customer to protect him, if possible, from his own mistakes; but competitors may have less scruple, and by doing what is wanted they may gain a temporary advantage." Sir Francis would, perhaps, reply that he was thinking of quantity sales rather than of unit sales; that is to say, of manufacturing rather than engineering. But even then there is a grave difficulty. Two powerful factors oppose modifications of design; they are standardisation, and mass, or quantity, production. With regard to the latter it is unnecessary to say anything, but in connection with standardisation it should be remembered that standard specifications are presumed to represent the best of their day. The very fact that they are, of necessity compromises between differences, may be counted to them for an advantage, for they are likely to have some qualities that satisfy everybody and none to which there are grave objections. But be that as it may, it would obviously be out of the question for manufacturers to adopt standards and then to modify them to suit the demand of a market which represented, perhaps, only a fraction of their turnover.

We discussed in our last issue a remarkable article by Sir Eric Geddes, in which mass production was set up as the key to prosperity. May we venture to suggest that in many instances the non-mass producer is of no less service to the industries of his country than the mass producer, just because, unhampered by expensive equipment, he is in a position to modify design readily and so to meet the requirements of the market upon which Sir Francis lays stress? A firm which is turning out goods by the thousand instead of the hundred thousand, and which is employing an organisation less costly than that

called for by the mass producer, may, quite conceivably, retain a market which the greater employer would have perforce to sacrifice and thus save it for still greater development under quantity production.

Problems of Electricity Supply.

FOR the most part the papers that were read at the Incorporated Municipal Electrical Association's thirty-sixth annual convention, held at Scarborough from Monday to Friday of last week, were quite informative and useful. Speaking at the annual dinner, held on Thursday, June 18th, Mr. Herbert Morrison remarked that national associations of local authorities served to pool the knowledge and experience of Chairmen of Electricity Committees and chief officers of the various public undertakings. Between three-fifths and two-thirds of the electrical supply industry, he went on to state, were managed by public authorities; nearly all the great towns and a large number of urban districts possessed their municipal supply undertakings, which during the past five years increased their output from 3910 to 6383 million units. But satisfactory as these figures are, Mr. Morrison made good use of the opportunity to emphasise the fact that there are still vast territories to be explored, not only in the sense of square miles, but also in respect of the diversity and intensity of the use of electrical energy. The policy of laying mains in advance of the actual demand for electricity was again put forward, together with other proposals for securing new business, a matter which, in view of the large amount of money that is being spent on the "grid," the Government cannot ignore. The national scheme does not, however, appear to be pleasing all concerned, for various speakers who took part in the discussion on the papers expressed the view that "grid" supplies are not conducive to extensive electrification. At Eastbourne, for instance, where the generating station is now closed down, it was possible in the past to supply current for heating water at one-third of a penny per unit, but now that a bulk supply has to be paid for at a higher rate than it previously cost to generate the current, it is doubtful if this tariff can be continued. Again, Mr. McKenzie, the Borough Electrical Engineer at Wimbledon, stated emphatically that undertakings which have to buy their electricity from the Central Board cannot afford to have "all-electric" houses on their mains.

In his presidential address delivered at Scarborough, Mr. A. J. Fuller drew attention to the policy of the Central Board in regard to the allocation of capital on transmission lines. Under the present arrangements the longer the line required to supply a given undertaking, the greater are the capital charges, with the result that in many cases it is impossible for an electricity undertaking to compete with plant in local factories. The whole of the cost of transmission should, in Mr. Fuller's opinion, have been pooled in such a manner that no undue hardship would be inflicted on any undertaking. Sooner or later, the President went on to say, "the Board would be compelled, either by legislation or otherwise, to absorb and embody in one general charge the 'grid' and transmission lines," and until that was done the original idea of the "grid" would never be carried out in practice. The cost of frequency standardisation, which incidentally is exceeding the estimates, is, of course, being spread over the whole of the undertakings, standard and non-standard alike, and if this sharing out scheme be extended much further the ultimate result will be that the exceptionally cheap electricity essential in certain industries will be unobtainable. As it is, factories in the neighbourhood of large and efficient generating stations can usually obtain current at a low price, but if they are going to be saddled with charges incurred by less favourably situated consumers, it will not be surprising if they become discontented. Certain large consumers are finding that, as the result of the "grid," they are being put to a good deal of extra expense in connection with their switchgear, on account of the fact that it must be capable of dealing with very heavy currents under fault conditions, and local generation in these cases is very apt to become attractive. The chief cause of the difference in the charges in industrial and rural areas is distribution, the great obstacle to cheap supplies in sparsely populated parts. Unified tariffs for town and country, as suggested at the convention, would no doubt be appreciated by those residing in rural parts, but unfortunately they could only be provided at the expense of the towns, and, in the opinion of Mr. H. C. Lamb, if the scheme were adopted the country might as well introduce communism at once.

Mr. Nichols Moore, the author of a paper on "The Future Development of Electricity Distribution in Great Britain," shows that it is only by effecting savings on the distribution side of the electricity supply industry that a real lowering of the average price per unit can be secured. He therefore suggests that in order to complete the task of rationalisation begun by the Act of 1926, covering generation and transmission, a similar scheme for the co-ordination of distribution should be adopted. But, as the author himself recognises, the proposal is liable to arouse much controversy. Desirable as cheap distribution is, many will view with concern the suggestion that there should be another national body. Material economies may be possible in distribution, but in the opinion of many any further step in the direction of nationalisation is undesirable. The establishment of the new Board would, of course, impose another charge on the industry, which should be able to solve its distribution problems without further official assistance.

Shipyard Labour and Wages.

By E. T. GOOD.

THE shipbuilding employers are pressing for a general revision of wages and employment conditions. At a conference with union representatives, April 24th, the Employers' Federation presented a considered report on the state of trade. On June 5th, the employers detailed their proposals for effecting economies. The trade unions concerned are considering the proposals, and further conferences between the two sides are being arranged, the next to be held June 26th. The employers suggest that any new terms or conditions agreed to shall become operative in September.

The circumstances are remarkable. Since 1920, the number of workers engaged in shipbuilding has been reduced by almost 50 per cent. Large numbers of men have left the industry, not even hoping to be employed again in shipyards. Of the greatly reduced number left attached to the industry, over 50 per cent. are unemployed. Fully 75 per cent. of building capacity is unemployed. We still lead in shipbuilding, but, whereas we had usually about 60 per cent. of the world's total merchant work in the last ten or twenty years before the war—we reached 66 per cent. sometimes—we have barely 30 per cent. of the total under construction to-day. In naval shipbuilding we have less than one-tenth of our normal pre-war volume of employment on this account.

In the matter of wages and trade union restrictions British and foreign conditions vary widely. American wages are much higher than ours, but the cost of shipbuilding is so high in the United States that we have no competition to fear from that country, except in cases where vessels are lavishly subsidised or otherwise assisted by the United States Government. Our real competitors are in Europe, and to-day, notwithstanding deep depression in shipping, the aggregate volume of work on hand in the shipyards of continental Europe is equal, if not more than equal, to the pre-war best level, whereas the volume on hand in British yards is barely one-third the normal pre-war amount.

Foreign shipbuilding is greatly assisted by various direct and indirect subsidies, special loans and credits, and some protective measures. Since the war we have built many ships for French owners. The French Government, by its new Maritime Credit and related measures or schemes, plans to have all vessels for the French flag built in French yards. We are likely to lose good customers. We have built a great number of ships for firms in Norway since the war; but by an arrangement between the shipowners, shipbuilders, trade unions, banks and the Government of Norway, the shipbuilding yards of that country are being modernised, and in future we shall get few orders from that quarter. Holland and Denmark and Sweden are building more ships than before the war, offering considerable competition against us for contracts. Italy is building about six times as many ships as before the war. So, whilst still keeping the lead, we are steadily losing ground as measured by percentage of the world's work. Needless to say, wages are lower on the Continent than in our country, and nothing like British trade union rules or customs are experienced abroad.

British shipyard wages were rather drastically reduced between 1920 and 1924. In 1927 some advances were made, though employers doubted the wisdom of increasing costs of production. Doubts have been justified. The position of British shipbuilding, alike as regards volume of work and percentage of the world's total, has worsened since 1927. The general position of British shipbuilding is worse than at any previous time since the steel age set in, though, in technique, management and the layout of yards, the British industry is at the top of the international ladder. We build ships better, in most cases quicker, and in some cases cheaper, than other countries; but the competition is rendered unequal, if not unfair, by high taxes and rates and certain trade union rules here, concurrent with lower taxation and wages, easier labour conditions, and generous State subsidies and loans and protective measures abroad.

In the matter of wages and labour there are two outstanding features, or circumstances. Whilst large numbers of our shipyard men are in receipt of wages lower than those paid in some other British industries—in municipal and railway work, for instance—there are sections of labour in our shipyards paid really enormous wages, even in these days of depression. In no industry and no country in the world is there such a disparity between certain skilled and certain unskilled wages as in the shipbuilding industry of Britain and Northern Ireland. And in no competitive country are there such trade union rules and customs, such rigid lines of demarcation, or so many water-tight sections of labour, as in our country.

Time wages in our industry average 60s. per week for skilled men on new work and 63s. on repair work, the corresponding figures for unskilled men being 41s. and 44s. There have been three wage revisions since 1922—two downward and one upward. The net result is that, as compared with the average levels of 1923–24, skilled men's wages have a purchasing power to-day fractionally over 48 per cent. higher than seven and eight years ago. The wage rates are higher by nearly 25 per cent., and there has been a fall of about 30 points in the cost of living index. As compared with 1914, skilled wages are increased by 46 per cent., and unskilled wages by 74 per cent., for a working week reduced by seven hours in some districts and by eight hours in others.

In piecework earnings there are anomalies. Skilled men on piecework average 2s. 2½d. per hour, and they work an average of forty-one hours per week. But the section called shell platers receive pays ranging from 2s. 6d. to 5s. 10d. per hour; frame platers get from 2s. 2d. to 4s. 8d. per hour; and platers on decks, bulkheads, and beams receive almost, if not quite, as much.

There has grown up in British shipbuilding a system of sub-contracting. Platers take work at agreed prices, employ and pay their "helpers," usually at time rates, and pocket the balance of the squad earnings. Under this system two or three platers may take more money than eight or twelve helpers. Of, say, £50 for the squad for the week's work, three platers may divide £30—£10 each—and eight helpers be left with £20—£2 10s. each. The pay of riveting squads is also very unequally divided, but not to the extent of the plating pay. In other sections of labour the arrangement is such that, though the employers are paying really a big price for the total labour, the majority of the workmen get relatively small shares, whilst a minority take big shares. The employers aim at securing reductions in case of the highly paid men. They have done something since the war to reduce the disparity between certain skilled and certain unskilled earnings, but there is still a very wide gap.

The employers desire also to effect economies in the matter of allowances for various jobs. It has long been the custom to pay an extra per day or hour—usually called "black" money—for dirty or specially difficult or awkward work, and practically all repair work or work on vessels not new, has been termed "black" or old work, besides which specified jobs on new vessels are subject to the extra allowances. It is the custom in continental shipyards to put the youngest men on the most unpleasant jobs, without extra pay or special allowances. It is contended by our employers that in at least some cases new methods or appliances recently introduced have so far changed the character of the jobs that the extra allowances can no longer be justified.

Relaxation of demarcation rules and customs is another matter being pressed by the shipbuilding employers. Whereas abroad labour is roughly divided into three classes—skilled, semi-skilled and unskilled—and men do jobs they are competent to do, as and when jobs turn up, without trade union rules, here we have about forty sections of labour, governed by as many separate trade unions, each section being practically in a water-tight compartment and claiming specified sections of work to the exclusion of other sections. It is not the ability of a man to perform a particular bit of work that counts here, but the trade union rule or claim regarding such work. Certain woodwork is reserved for joiners and other woodwork for shipwrights. Certain metal work is reserved for brassfinishers, other work for coppersmiths, and yet other jobs in the same line for engineers, not to mention electricians. Certain ironwork is claimed by blacksmiths and very nearly related work by boilermakers, fitters and others. These strict demarcation rules or customs, frequently cause unnecessary delays and lead to unnecessary cost of production. There is nothing like such a system abroad. A few years ago, after investigation abroad, representatives of the shipyard trade agreed with the employers that there was a case for the "interchangeability" of labour in our industry, in order to facilitate production, and they reported that such interchangeability need not be detrimental to labour or infringe the principles of trade unionism.

The trade union leaders, having heard the views and proposals of the employers, have submitted the facts to the members; joint discussions by the unions

are proceeding; and there will be negotiations between the unions and the Employers' Federation, beginning on June 26th. So far, friendly relations exist between the parties.

Irrigation in India—1928-29.

IT appears from the recently issued annual review that during the year 1928–29 the total area irrigated by Government works of all classes in British India was 30·7 million acres, which is 2·4 million acres more than the previous record area of 28·3 million acres irrigated in 1922–23, and nearly 2·7 million more than the average of the previous triennium, 1925–26, 1926–27, 1927–28.

The area irrigated was largest in the Punjab, in which province 11·5 million acres were irrigated, or about 800,000 acres more than the previous record of 10·7 million acres in 1922–3 and over a million acres more than the average for the triennium ending 1928. In addition, 1·5 million acres were irrigated from channels which, although drawing their supplies from British canals, lie wholly in Indian States. The Madras Presidency came next in importance, with an area of 7·3 million acres, and was followed by the United Provinces with an area of 4 million acres, thus establishing a new record for that Province. In Sind 3·6 million acres were irrigated.

The total capital outlay, direct and indirect, on irrigation and navigation works, including works under construction, amounted at the end of the year 1928–29 to Rs. 12,302 lakhs. The gross revenue for the year was Rs. 1176 lakhs, and the working expenses Rs. 506 lakhs, the net return on capital being, therefore, 5·4 per cent. Of the several provinces, the return on the capital invested in productive works was highest in the Punjab, where the canals yielded 12·52 per cent. In Madras the percentage of return on such works was 7·94, while in the United Provinces 4·56 per cent. was realised.

The total area irrigated by Government works during 1928–29 was 12·1 per cent. of the total area under cultivation.

WORKS COMPLETED AND THE PROGRESS.

Bombay Deccan.—The Lloyd Dam at Bhatgar, impounding 24,000 million cubic feet of water, was completed, as were most of the earthworks and masonry works of the Nira Right Bank Canal, 106 miles long. The Visapur Tank and Canal project was commenced in 1896 as a famine work, carried on by convict, criminal tribes and ordinary labour, and was completed in December, 1929, at a cost of over Rs. 40 lakhs. It comprises a dam storing 1218 million cubic feet of water and a canal about 11 miles long, designed to irrigate some 13,000 acres in the *rabi* season in Ahmednagar Collectorate.

United Provinces.—The Jaiwanti, Khandeha, and Raipura tanks, and a series of protection works on the Katapathar Canal were completed.

Punjab.—Drainage, to prevent waterlogging, on the Upper Chenab and Lower Jhelum canals, and most of the 150,000 acres extension scheme, Burala branch, Lower Chenab Canal, was completed.

North-West Frontier Province.—Remodelling and extension of the Bakhshali Distributary, a work which is part of a project to irrigate from the Upper Swat Canal the land now irrigated by the Kalpani Distributary of the Lower Swat, as the latter distributary runs across the natural drainages of the country; and the construction of Gaddar Minor, from the Jamalgarhi Distributary of the Machai branch of the Upper Swat Canal, were completed.

Madras Presidency.—Good progress was made with the Cauvery (Metur) project. Many large masonry works were fully or nearly completed. The expenditure up to the end of 1928–29 amounted to Rs. 256 lakhs. The Polaveram Island project, estimated to cost Rs. 18·55 lakhs, to irrigate 16,316 acres of fertile land in the Godaveri Delta, and the Basavannah Channel improvements, intended to extend irrigation to an area of 3349 acres in the Bellary district and estimated to cost Rs. 5·5 lakhs, made progress.

Sind.—On the Lloyd Barrage and Canals, out of a total of 564 crores (5640 million) cubic feet of earthworks in the whole project, 247 crores (2470 million) cubic feet had been done at the end of March, 1929 and of 6211 miles of canals and branches, 1300, chiefly the largest sections, had been completed. The superstructure of five spans of the scouring sluices and of one and a-half spans of the barrage proper on the right bank was raised up to the springing level of the gate bridge piers. On the left bank the piers of the seven scouring sluices and two and a-half spans of the barrage proper were raised to the springing level of the road bridge arches, and the gate bridge portion was raised to R.L. 198. The programme adopted for the 1928–29 season was thirteen spans of the barrage on the left bank and ten spans on the right bank, and this was carried out by the end of June, 1929. The superstructure masonry of the three head regulators on the right bank was carried up to R.L. 229. All the arches for the twenty-three spans of the three regulators were completed. On the left bank the superstructure of the four regulators was completed up to the springing level of the arches. The downstream guide bank on the left bank was practically finished, and on the right bank about three-fourths of the guide bank was completed during the year.

Bengal.—The Damodar Canal, which may be partially opened this year, comprises about 230 miles of canals and will irrigate 180,000 acres of rice in the Burdwan and Hooghly districts.

The headworks of the Bakreswar Canal were nearly finished. This scheme provides for the irrigation of about 10,000 acres of rice land.

United Provinces.—Against the sanctioned estimate of Rs. 951 lakhs, expenditure on the Sarda Canal project up to the end of the year was Rs. 852 lakhs. For experimental purposes, and to kill the "elephant grass" which had grown up in the bed, the canal was opened on June 19th. The formal opening took place on December 11th, 1928, but some channels were not completed.

On the hydro-electric power works for utilising the falls on the Ganges Canal, partly for irrigation by pumping and partly for domestic and industrial purposes, a sum of Rs. 24,72,707 was spent during the year.

Punjab.—The Sutlej Valley project in this province includes (*a*) the British canals Pakpattan, Dipalpur, Eastern and Mailsi; and (*b*) the State Canals Bikaner, Fordwah, Eastern Sadiqia, Bahawal, Abbasia and Panjnad. All but the last two of these canals were in operation during the year. The expenditure incurred on the project to the end of 1928–29 amounted to 1750 lakhs of rupees, which includes 903 lakhs contributed by the States of Bikaner and Bahawalpur, the co-partners in the project.

Burma.—Satisfactory progress was made with the earthwork of the Sinbyugyun Distributary, North Mon Canal extension project. Embankments in Lower Burma were raised and strengthened. Dredgers were employed in improving waterways in the delta and in reclaiming areas in deltaic towns.

Central Provinces.—Excellent progress was made on the remodelling of the main Tandula Canal and the distributaries. The remodelling of fifty channels has been practically completed. The expenditure incurred during the year was Rs. 12·73 lakhs.

In connection with the Kharung Reservoir good progress was made on the construction of the right and left bank canals and the headworks, which were almost completed. The expenditure incurred during the year was Rs. 5·07 lakhs.

Very good progress was made on the construction of the headworks, the main canal and the distributaries of the Maniari Canal. The headworks and all the main channels will be ready for irrigation by the rains of 1930. The expenditure during the year was Rs. 10·57 lakhs.

WORKS PROJECTED.

Amongst projected works may be noted:—

Markandeya River.—Storage, to irrigate 19,000 acres.

Meshwa Canal.—Estimate Rs. 15·88 lakhs. To feed the Khari sluices and to provide for the needs of villages in Gujerat.

Reservoirs with Canals.—Panam River, Rs. 2 crores; Watrak River, Rs. 1¼ crores.

Irrigation from Rivers.—The More River, 63,000 acres; the Darkeswar River, 200,000 acres; the Suvankar's Danra River, 16,000 acres, estimated areas. If conditions at a proposed site favour the building of a dam, the irrigable area of the More River may be extended.

Lift Irrigation of 3000 acres of land in the vicinity of Durgai Rest House. Lift irrigation of the uncommanded area to the left of the Machai Branch near the tail of the Shamozai Distributary by developing power from falls on the Machai Branch. A hydro-electric scheme for lifting water from near the head of the Kabul River Canal to water an uncommanded area of over 15,000 acres, part of which is at present being served by the uncertain supply of the Bara Canals.

The two parts of the review, descriptive and financial, are complementary as well as separately informative, providing, at the price of Rs. 1·2·0, or 2s., a fund of interesting information by no means confined to the year under review.

Literature.

The Reclamation of Land from the Sea. By F. M. DU-PLAT-TAYLOR, M. Inst. C.E., M.I. Mech. E., M.I. Struct. E., M. Cons. E., M. Soc. I.C. (France). London, 1931: Constable and Co., Ltd. Price 21s. net.

THE more thoughtful of those who control or influence public expenditure must sometimes feel that what is spent upon means of dealing with what we produce is very large compared with expenditure upon measures for increasing or cheapening production. More widely is it believed that neither world conditions nor Empire conditions fully prescribe the economic policy of Great Britain; that we ought to produce more of what we consume and import less of what we can produce, and that if an industrial revival is in sight we should be prepared largely to increase the yield of the land. On the broader ground of ultimate expediency, many engineers and others may be prepared to support a policy of land reclamation. To such persons, as well as to many others interested in dormant schemes or local possibilities, Mr. Du-Plat-Taylor's book may very confidently be recommended, as adequately presenting the technical and economic aspects of such works and very usefully explaining the present situation in regard to land reclamation. In respect of the return, immediate or ultimate, which the promotors of reclamation schemes may hope to obtain from expenditure of capital, the odds against success may be halved, or the odds on success doubled if advantage can be taken of the Government grant of about 50 per cent. of the cost of approved schemes providing employment for men from distressed areas; while, in regard to procedure and the raising of loans, reclamation works may sometimes be facilitated under powers conferred upon the Catchment Area Boards by the Land Drainage Act of 1930.

The immediate difficulties are very fairly stated in the author's preface, and in the opening paragraphs of his chapter on "The Economic Scene." The price of land, he points out, is now so low that reclamation seldom recoups expenditure. Furthermore, the very low average productivity of English land now being farmed leaves available a large margin for increased yield, before new land would be actually needed. The author hopes, however, that a protective tariff will make England again an agricultural country, and that the reclamation of land from the sea will once more assume the importance it had in the days of the enclosure of the Romney Marsh and the draining of the Lincolnshire fens. He also points out that reclaimed land is, by virtue of its situation, often valuable for industrial, harbour and building purposes.

To these aspects of the subject Mr. Du-Plat-Taylor has devoted only about two pages of his very informative and well-written technical work. The subject is well covered, as regards the factors affecting reclamation by enclosure and by filling, the methods followed and the machines used, and embankments, surface protection and other works, whilst there are abundant costs data relating to whole schemes, main items, details of works, and the performance of machines. The lay-out of reclaimed areas is discussed, with a good study of rainfall and sluice discharges and with excellent drawings and engravings of sluices. Reclamation by filling is explained by means of examples, filling by disposing of dredged material being described at some length. Reclamation by drainage alone is discussed in a few pages, the author concluding that reclamation can seldom be effected in this country by drainage alone, at any rate on the coast. This may be true as regards the immediate reclamation of considerable areas, but it may be doubted whether it be true in respect of gradual seaward growth of a portion of coast line, where the deciding factor between erosion and accretion is the local drainage from the land. It may also be observed that, although it is explained that existing streams should, if possible, be diverted from an enclosed area and surface water from other land be intercepted, no reference is made to the minority opinion, that, in many cases, such measures may make it unnecessary to drain the enclosed area itself, except by a very few shallow ditches.

In a brief introduction to the book, written by Mr. G. L. Courthope, the opening and concluding sentences are: "The story of land reclamation is full of romantic interest, and Mr. Du-Plat-Taylor's book will be widely welcomed by all who study the story of our sea-girt island." . . . "We know all too little of the history and problems of our unceasing struggle with the sea, and this book will go far to remedy our ignorance." The natural inference is that the volume is a more or less popular work, appealing to a wide circle of readers outside the profession of engineering. In justice to the engineer who has written it, in such a manner and with such choice of material that it may be recommended to all civil engineers and students of civil engineering, it must be pointed out that Mr. Courthope's introduction may give a false impression of the character of this work. Although it will interest a considerable number of persons who wish to be well informed on such subjects, and may earnestly be commended to the notice of statesmen, economists, and all persons interested in the subject or in specific proposals for the reclamation of land, it is essentially a book for engineers.

BOOKS RECEIVED.

The Railway Year Book for 1931. London: The Railway Publishing Company, Ltd., 33, Tothill-street, S.W. 1. Price 5s. net.

Cross-Country Flying. By Major Oliver Stewart, M.C. London: Constable and Co., Ltd., 10, Orange-street, W.C. 2. Price 6s. net.

Civil Engineering Design. By A. A. Fordham, B.Sc., &c. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 21s. net.

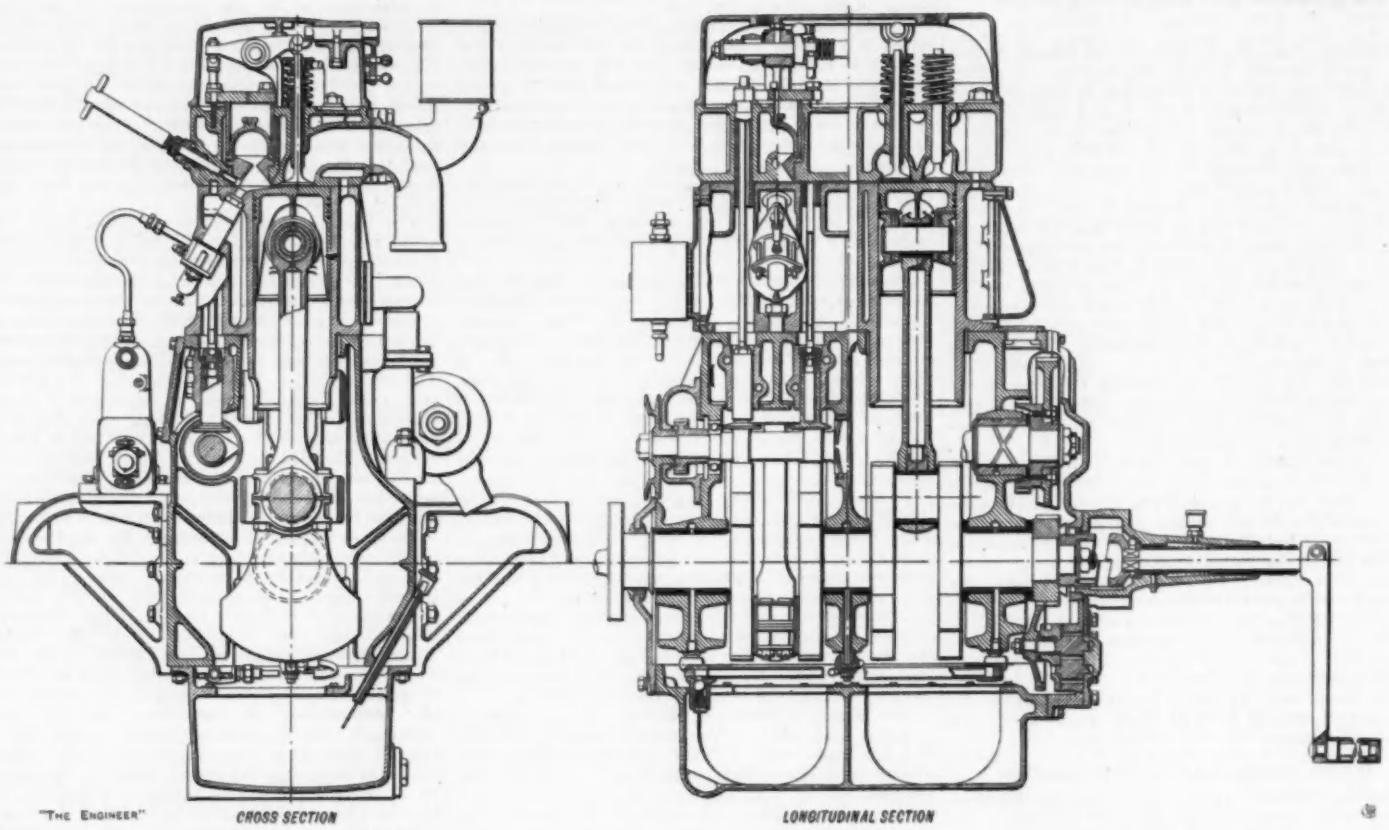
Reinforced Concrete Bridges. Third edition. By W. L. Scott, assisted by C. W. J. Spicer. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 28s. net.

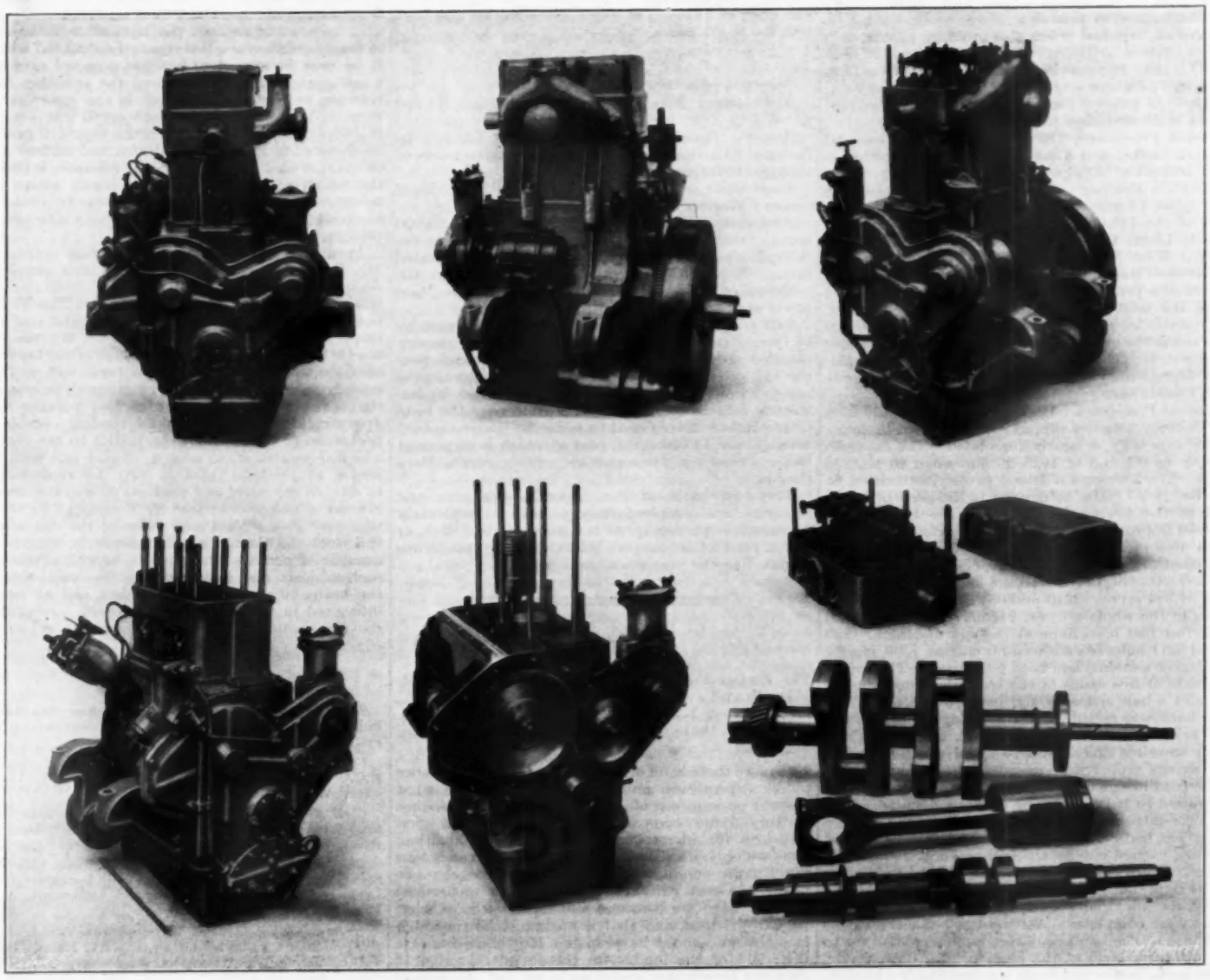
Untersuchungen über den Wärmeverbrauch der Wohnung. By Professor C. Eberle and Dr.-Ing. W. Raiss. Berlin: V.D.I. Verlag G.m.b.H., Dorotheenstrasse 40, N.W. 7. Price 7·20 marks.

12-26 B.H.P. TWO-CYLINDER C.I. OIL ENGINE

W. H. DORMAN AND CO., LTD., STAFFORD, ENGINEERS

(For description see opposite page.)





A New Compression-Ignition Oil Engine.

THE oil engine which we illustrate by the engravings on page 712 and below has recently been produced by W. H. Dorman and Co., Ltd., of Stafford. It uses heavy oil, is of comparatively small size, employs solid injection, and runs at a reasonable speed.

At present it is being made only in the two-cylinder form, with a bore of 110 mm. and a stroke of 180 mm, developing 12 brake horse-power when running at 600 revolutions per minute, or 35 horse-power at 1800 revolutions per minute. It is not, however, recommended that it should be operated continuously at a greater speed than 1250 revolutions per minute, when the output is about 26 horse-power. It is noteworthy, in this connection, that it runs remarkably steadily when throttled down, and we have brought it down almost to the point of stalling without a misfire, while the exhaust remained a pale grey throughout a very wide and abrupt range of loads.

The engine is constructed under the licence of the Acro patentee; that is to say, the cylinder head contains a small separate combustion chamber, which is connected with the cylinder space proper by a restricted orifice. Into this space the air for combustion is compressed and at the top of the piston stroke the fuel is injected. Our cross-sectional drawing shows the form of the chamber quite clearly and also how the fuel jet is arranged to point diagonally upward into the chamber. The jet and the fuel pump, which is shown on the bracket below, are of the Bosch type.

The cylinders are cast in pairs and have detachable heads containing the overhead valves. They are secured to the crank case by long through bolts, which take the tensile stresses right through the engine from the cylinder head to the bearings of the crank shaft. These bolts are plainly shown in two of our half-tone engravings, which also illustrate several stages in the dismantling of the engine—a process which we witnessed ourselves. It occupied only a quarter of an hour, although the engine had just come off full load and, consequently, was decidedly hot to handle.

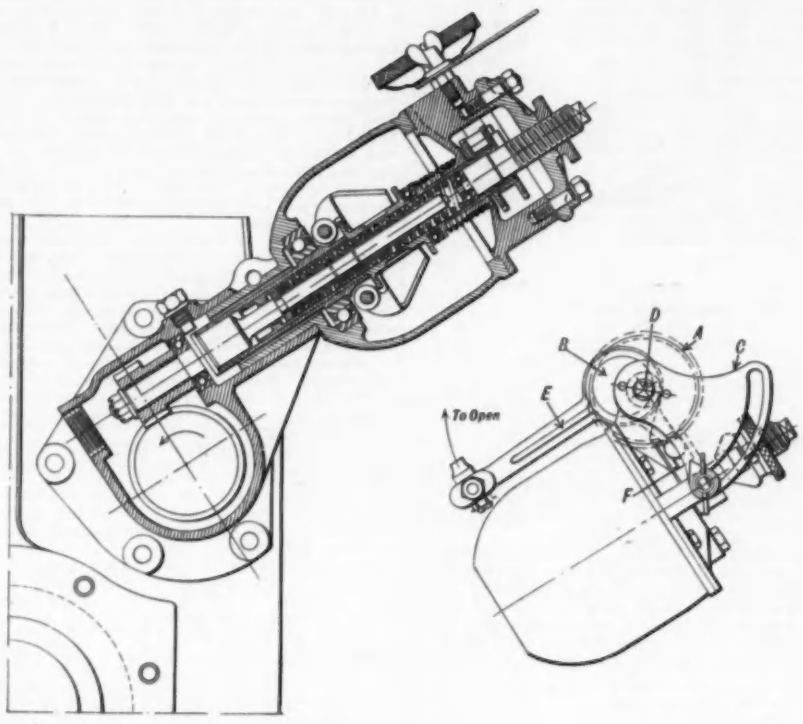
The cover which encloses the valve rockers, springs, &c., is held in place by six bolts and is readily removed if these parts require attention. Then comes the cylinder head, held by the through bolts already mentioned, six of which reach down to the crank shaft bearers. There are also four other holding bolts, which are bored and serve as passage-ways for the push rods for operating the valve gear. Thus by liberating the nuts on these bolts and the one or two connections for the inlet and exhaust, the whole cylinder head, together with the valve gear, can be removed.

The next stage in dismantling, should it be necessary for, say, cleaning purposes, is the lifting off of the cylinder block, and that requires the casting off of the nuts on four studs and the fuel valve connections. The timing gear case is easily removed and then, it may be said, the engine is fully open for inspection and overhaul. The sequence of these operations is shown in our engravings, together with some of the separate parts after they have been dismantled.

The crank shaft is a forging of high-tensile steel with the balance weights made integral with the webs. The main bearings are 3¼in. in diameter. The connecting-rods have steel shells with white metal linings at the big ends and phosphor-bronze bushes for the gudgeon pins. The pistons are cast in aluminium alloy and have four rings above the gudgeon pin.

We give a separate drawing of the governor, which shows how the hand control knob A, the excentric B, and the quadrant C are all fixed to the spindle D, which is mounted in bearings on the governor end cover, transversely to the axis of the governor. Mounted freely on the excentric B is a bell crank lever E, the longer arm of which is connected directly to the regulating rod of the fuel pump. The end of the shorter arm is made spherical and inserted between two flanges on the governor sleeve F. When the knob A is turned by hand the excentric B turns with it and throws over the bell crank lever E and so moves the regulating rod of the pump, during which operation the spherical end of the lever becomes almost a fulcrum point and has no effect on the governor sleeve F. The quadrant C is for securing the control in any desired position. Even when the control is fixed, however, the bell crank lever E is still free to oscillate on the excentric B, and any movement of the governor sleeve F causes it to do this. The governor is therefore able to take charge independently of the hand control. The governor itself is of the orthodox centrifugal type, except for the fact that two springs are used. It is mounted at the rear end of the engine and is driven at engine speed from the cam shaft.

The engine is of such characteristics that it can be easily started by hand, when cold, without the aid of any initial firing devices, but is sometimes fitted with two Bendix electric starting motors, as shown in the engravings. It will run on practically any grade of oil from paraffin to fuel oil having a viscosity of 50 seconds on the Redwood scale at 100 deg. Fah. Its fuel consumption is put at 0·45 lb. per B.H.P. per hour with an average grade of Diesel oil. The weight of the engine, with a specially heavy fly-wheel, is 16 cwt.



DETAILS OF GOVERNOR

Steam Nozzle Efficiency.*

THE SIGNIFICANCE OF THE TERM "EFFICIENCY" AS APPLIED TO STEAM NOZZLES.

By J. C. OAKDEN, M.A., M.Sc. Tech., Associate Member.

IN recent years a large amount of experimental work has been performed upon the flow of steam in nozzles, with the object of providing information for use in the practical design of steam turbines. The methods used in these researches, and in particular that adopted by the Steam Nozzles Research Committee of the Institution, have often been criticised upon the ground that from the published numerical results it is not possible to estimate the true "efficiency" of any nozzle, according to the usual definition of that term. Such criticism is worthy of serious consideration, since it affects the practical value of almost the whole of the experimental data of the subject. The author has therefore been led to inquire into the precise meaning of nozzle efficiency as usually defined, and into the extent to which the results of experiment can be accepted as representing the actual performance of steam turbine nozzles.

The ordinary forms of nozzle tests, known respectively as the "impulse" and "reaction" methods, consist essentially of a process of measuring the momentum of the steam jet issuing from a nozzle. The momentum of the steam issuing in a given time, divided by the mass of steam, gives the mean velocity of the jet on a basis of mass. The result of each test is usually presented as a "velocity coefficient," which is obtained by dividing the mean velocity by the theoretical or "adiabatic" velocity calculated as for frictionless flow. Representing by v the velocity of a small mass $d\,m$ of steam, and by V the adiabatic velocity, the velocity coefficient may be expressed by the ratio—

$$\int v \,.\, d\,m / \mathrm{V} \int d\,m$$

the integrations extending over the whole mass of steam leaving the nozzle in a given time. If the velocity were uniform in all parts of the jet, the expression would reduce to the simple form (v/V), and its square would then be exactly equal to the efficiency of the nozzle. On this basis it has been commonly assumed, in putting experimental results to practical uses, that the efficiency of a nozzle can be closely represented by the square of the velocity coefficient. If the usual definition of efficiency be employed, however, this procedure is not strictly justifiable in actual cases where the velocity is not uniform, and has been the cause of the criticism referred to above.

In the theoretical treatment of the subject, the efficiency of a nozzle is defined as the ratio of the total kinetic energy of the steam jet to the total input energy; the latter being taken as the adiabatic heat drop of the steam plus a correction for the kinetic energy of the steam entering the nozzle. Using the same notation as before, the efficiency is equal to—

$$\int v^2 \,.\, d\,m / \mathrm{V}^2 \int d\,m$$

and is not, in general, equal to the square of the velocity coefficient.

This definition has been generally accepted as standard. On closer examination, however, it can be shown to be quite unsatisfactory as a criterion of the performance of the nozzles used in steam turbines. It suffers from two serious defects.

First, the total kinetic energy of a steam jet includes the rotational energy of any eddies or vortices which the jet may contain. Such eddies are known to be present in actual jets, except perhaps those of extremely low velocity. Since this kind of energy cannot be measured by any known form of instrument, the value of the "efficiency" of any nozzle cannot be discovered, and so is quite useless for all practical purposes.

Secondly, even though the definition might be altered so as to exclude the energy of eddies, there would be no reason to suppose that the amount of the remaining kinetic energy would be a true measure of the useful energy of the jet. In any nozzle the velocity of the steam has very different values in different parts of the cross section, and the amount of useful work which can be extracted from the steam in the turbines depends not only on the total kinetic energy but also on the manner in which the velocity is distributed over the cross section. In probably every steam turbine there are some parts of the jets which move so slowly as to be worse than useless in the production of useful power output, and to include the kinetic energy of these parts in the category of useful energy must surely be erroneous.

It thus appears that as a means of assessing the merits of actual steam nozzles, the ordinary theoretical definition is inadequate. Nevertheless, steam turbine designers and all who are interested in steam turbines possess a more or less definite idea of what is meant by the "efficiency" of nozzles, and it is necessary to discover whether some better means cannot be found of expressing this idea with sufficient precision to form a definition of what may be called the "practical efficiency" of a nozzle.

From the point of view of the turbine designer, the most efficient nozzle is one which, with a fixed rate of energy input and working in conjunction with suitably designed blades, enables the maximum quantity of useful work to be performed on the turbine blades in a given time. Other things being equal, the best nozzle is one in which the whole of the steam approaches the blades with a uniform and definite speed. In practice the speed is not uniform in different parts of the jet, and since the blading cannot be made to deal equally well with steam moving with widely differing velocities, the work done on the blades is diminished. It is well known that for any given kind of blade—of either the impulse or reaction type—working with constant blade speed u and variable steam speed v, the blading efficiency is represented closely by a parabolic expression of the form—

$$a\,(u/v) - b\,(u/v)^2$$

In a steam jet of varying velocity, therefore, the work done on the blades by a small element of steam of mass $d\,m$ moving with velocity v is nearly equal to—

$$\tfrac{1}{2}\,v^2\,[a\,(u/v) - b\,(u/v)^2]\,d\,m$$

The total work done by a mass M of steam is thus—

$$\tfrac{1}{2}\,a\,u \int v \,.\, d\,m - \tfrac{1}{2}\,b\,u^2\,\mathrm{M}$$

If v_o is the mean velocity of all the elements of mass of the steam, we have—

$$v_o = \int v \,.\, d\,m / \mathrm{M}$$

And the work done is equal to—

$$\tfrac{1}{2}\,(a\,u\,v_o - b\,u^2)\,\mathrm{M}$$

or—

$$\tfrac{1}{2}\,v_o^2 \left[a \left(\frac{u}{v_o}\right) - b \left(\frac{u}{v_o}\right)^2 \right] \mathrm{M}$$

This is identical with the work which would be done by the same mass of steam moving with uniform velocity v_o. It therefore appears reasonable to regard any steam jet, in regard to its effectiveness in producing work in a turbine, as equivalent to a jet of equal rate of mass discharge and moving with a uniform velocity equal to the mean velocity v_o of the actual jet; and to take as the useful energy content of the jet per unit mass the kinetic energy $(\frac{1}{2}\,v_o^2)$ of the equivalent uniform jet.

This result may be utilised to form the basis of a rational definition of the "practical efficiency" of a nozzle. The "efficiency" so specified is equal to the ratio of the useful energy to the input energy, the useful energy per unit mass being defined as above. Or in symbols—

$$\text{"Practical efficiency"} = \frac{\tfrac{1}{2}\,v_o^2}{\tfrac{1}{2}\,\mathrm{V}^2} \text{ or } \left(\frac{v_o}{\mathrm{V}}\right)^2$$

But the ratio (v_o/V) is the velocity coefficient of the nozzle. On this definition, therefore, the efficiency becomes automatically equal to the square of the velocity coefficient.

It may be contended that this relation is not mathematically exact, on account of the approximate nature of the assumed equation of blade efficiency. The discrepancy could be corrected by adding other terms to the blade efficiency expression, but in the ordinary high-efficiency nozzle it is of the third order of small quantities, and is negligible as compared with the errors of experimental determination of efficiency.

Thus the conception of a "practical efficiency" of a steam nozzle, defined as the square of the velocity coefficient, provides a very valuable means of estimating and comparing the performances of nozzles as used in practice, and the author ventures to suggest that it is worthy of adoption as a standard definition. Its advantages for practical purposes over the older definition of

* Two papers circulated for discussion in writing by the Institution of Mechanical Engineers.

"absolute" efficiency are sufficiently evident. Its outstanding virtue is its direct and very nearly exact relation to the capability of the nozzle for the production of useful work when mounted in a steam turbine. The "practical efficiency" can be found with ease, for any nozzle, by the ordinary velocity coefficient test, and for many shapes of nozzle its value is already known. A further advantage of its use is that the efficiency of the blades of a turbine is thereby rendered almost exactly independent of the velocity distribution of the steam jets which operate them.

There are, of course, other factors which play a part in determining the suitability of a nozzle for use in turbines; as, for example, the direction of the jet and its variation in different parts of the cross section. It would be difficult, however, to frame a definition of efficiency to include these, and it seems necessary to exclude them, at least for the present.

In conclusion, it may be remarked that the distinction between the mean velocity and the root-mean-square velocity of a steam jet was pointed out as early as 1913 by Professor Stodola, and in England by Mr. H. M. Martin in 1915. In choosing an experimental method for their nozzle tests, the Steam Nozzles Research Committee cannot have been ignorant of the distinction. The author believes that the decision to measure the velocity coefficient was a deliberate one, made with full understanding of the practical significance and value of this quantity.

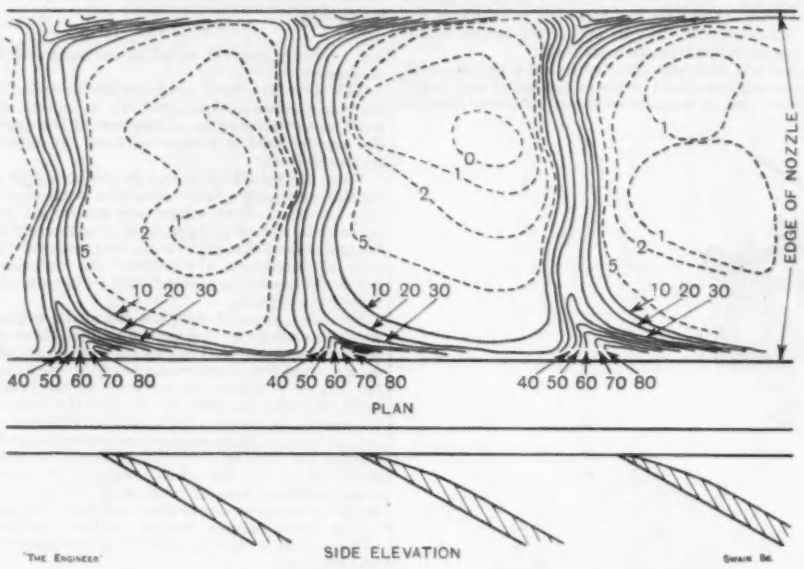


FIG. 1—VIEW OF NOZZLE SHOWING LINES OF EQUAL ENERGY LOSS

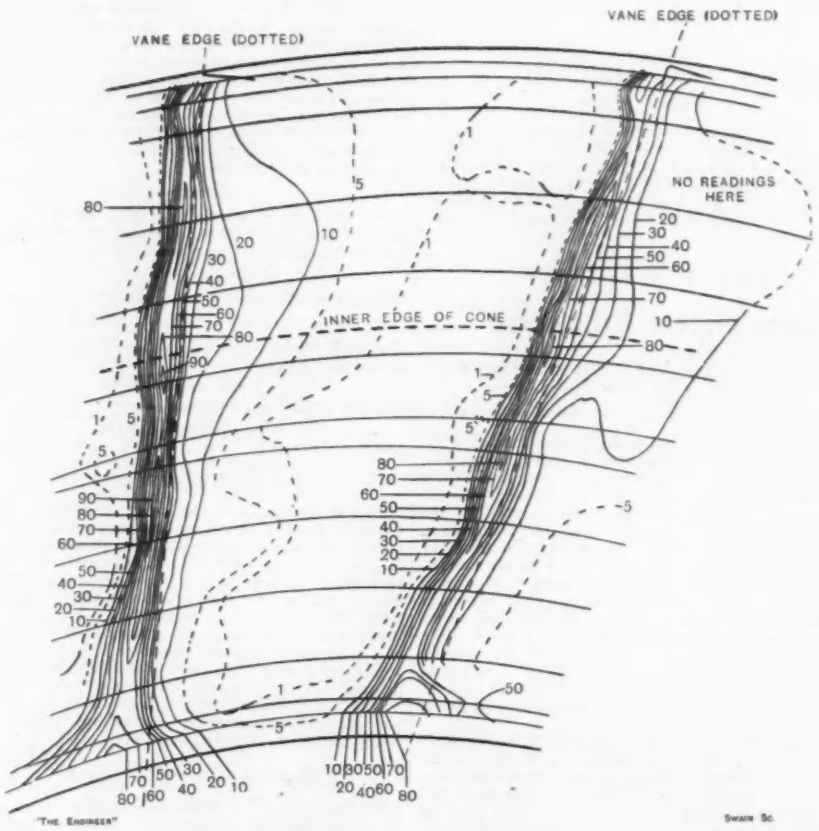


FIG. 2—ENERGY LOSS CONTOURS

THE AMOUNT OF DECREASE OF NOZZLE EFFICIENCY CAUSED BY NON-UNIFORMITY OF VELOCITY DISTRIBUTION.

By B. HOPKINSON, M.Sc., Associate Member, and A. E. DEVEY, B.Sc., Associate Member.

Arising out of the Sixth Report of the Steam-Nozzles Research Committee the suggestion was made in the technical Press† and elsewhere that the method of studying the results adopted by the Committee was strictly rational only if the velocity of the steam were constant across all sections of the nozzle steam.

It was pointed out that if there were substantial variations in the velocity at different points across the stream, then there would be a difference between the velocity coefficient as measured in the Committee's apparatus and the square root of the nozzle efficiency, where by the nozzle efficiency is meant the ratio of the actual kinetic energy per unit mass of the jet to that which it would have, if the steam had expanded adiabatically.

To investigate the magnitude of this difference the authors carried out tests to determine the distribution of velocity over the exhaust face of a nozzle.

The experiments were carried out in the Steam Experimental Department at Trafford Park on two nozzles of very different type. The results gave the energy distribution plotted in the contour diagrams—Figs. 1 and 2. While the velocity distribution was obtained and might have been plotted, it is more convenient for analysis to show the energy loss contours. If φ is the velocity coefficient at any point, or the ratio of actual to adiabatic velocity, then $1-\varphi^2$ is the energy loss per unit area at that point and is the function plotted as contours. For instance, if φ is 0·99 at a particular point, then $1-\varphi^2$ is 0·0297, which corresponds to an energy loss of 2·97 per cent. at that point. The 2·97 contour is, therefore, drawn through that point.

The mean velocity coefficient over the complete area can, for nozzles No. 1 and No. 2, be deduced from the data given in Figs. 1 and 2 respectively. These results are given in Table I.

TABLE I.

Nozzle tested	No. 1.	No. 2.
Velocity coefficient (φ)	0·9642	0·9594
$\sqrt{\text{Efficiency}}$ ($\sqrt{\eta}$)	0·9676	0·9622
$(\sqrt{\eta}-\varphi)$	0·0034	0·0028
$(\sqrt{\eta}-\varphi)/\varphi$, per cent.	0·35	0·29

It is necessary to consider how the value of φ enters into the expression for the quantity, the momentum and the energy of the flowing stream leaving the nozzle. In order to simplify the analysis the variations of efflux angle and of specific volume in the exit plane of the nozzle face are neglected. It can be shown that the effect of this simplification is negligible in the final result of this investigation. For any element of area δa of the nozzle outlet face, since φ is a measure of the velocity, then $\varphi\,\delta a$ will be a measure of the mass leaving that area, $\varphi^2\,\delta a$ a measure of its momentum and $\varphi^3\,\delta a$ of the energy leaving that particular element of area. Thus, for the whole area $\iint \varphi^3\,da$ will represent the total energy leaving in unit time and $\iint \varphi^3 / \iint \varphi\,da$ will represent the mean energy per unit mass, and will actually be the efficiency. The mean velocity coefficient will, of course, be $\iint \varphi^2\,da / \iint \varphi\,da$. This is always less than the square root of the efficiency. An Amsler planimeter was used for the double integrations $\iint \varphi\,da$, $\iint \varphi^2\,da$ and $\iint \varphi^3\,da$ by first integrating the curves of φ and its powers along the nozzle and then integrating the resulting mean values across the nozzle.

The efficiency of nozzle No. 1 was also measured at Trafford Park by an impulse type tester very similar to that used by the Steam-Nozzles Research Committee. For the same steam conditions as obtained during the impact tube tests the velocity coefficient obtained in this way was 0·9645. The agreement of this overall figure with the value 0·9642 deduced from the measurements of impact pressure at different points over the nozzle area is good. Further, in these particular tests the velocity coefficient is less than the square root of the actual efficiency as above defined, by 0·35 per cent. and 0·29 per cent. for the two nozzles respectively.

To examine the matter further and in order to be able to assess the probable range of values of this difference

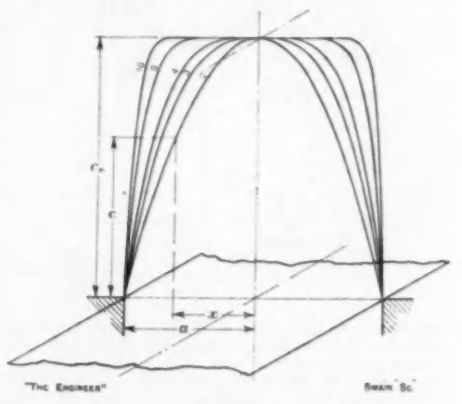


FIG. 3

for various cases, the authors assumed a distribution of velocity over the nozzle area which corresponded closely in type to that found in their experiments and yet was susceptible to mathematical treatment.

As a first example consider the steam as issuing from a nozzle having a rectangular outlet orifice of width $2a$ and of infinite length with the velocity distribution shown in Fig. 3. The velocity c in a transverse section falls from a value c_o at the centre to zero at the edges according to a law $c=c_o\left[1-\left(\frac{x}{a}\right)^n\right]$. The velocity need not be normal to the plane of the nozzle, but if inclined to it will be assumed to have a constant inclination. It will be found that with values of n of 8 and over, the form of the velocity distribution curve in Fig. 3 resembles fairly closely the actual distribution found in the authors' experiments. Since density is assumed uniform, the discharge from any strip δx wide is proportional to the velocity, while the momentum is proportional to the velocity squared, and the kinetic energy to the velocity cubed. Integrating over the outlet area—

the mass flow

$$=c_o\int_o^a\left[1-\left(\frac{x}{a}\right)\right]dx=c_o a\left[\frac{n}{n+1}\right]$$

the total momentum

$$=c_o^2\int_o^a\left[1-\left(\frac{x}{a}\right)\right]^2 dx=c_o^2 a\left[\frac{n-1}{n+1}+\frac{1}{2n+1}\right]$$

the total kinetic energy

$$=c_o^3\int_o^a\left[1-\left(\frac{x}{a}\right)\right]^3 dx=c_o^3 a\left[\frac{n-2}{n+1}+\frac{3}{2n+1}-\frac{1}{3n+1}\right]$$

For instance, if $n=2$, these three expressions become $\frac{2}{3}c_o a$, $\frac{8}{15}c_o^2 a$ and $\frac{16}{35}c_o^3 a$ respectively.

Assuming that c_o is the adiabatic velocity of the steam, then the velocity coefficient given by a nozzle tester of the impulse type will be proportional to $\left(\frac{\text{momentum}}{\text{discharge}}\right)$ or

$\left[\frac{2n}{2n+1}\right]c_o$, which equals $0{\cdot}8\,c_o$ if $n=2$.

The efficiency, if defined as being $\left(\frac{\text{kinetic energy}}{\text{discharge}}\right)$ will be represented by—

$$\left[\frac{n-2}{n}+\frac{3(n+1)}{n(2n+1)}-\frac{n+1}{n(3n+1)}\right]c_o^2;$$

† The reference is presumably to a letter which appeared in our correspondence columns in our issue of March 7th, 1930.—ED. THE E.

which equals $\frac{24}{35} c_o^2$ if $n=2$. Thus, in this case for $n=2$ the discrepancy between the square root of the efficiency and the velocity coefficient, *i.e.*, $\sqrt{\eta}-\varphi$, is 0·0277, which may otherwise be expressed by saying that $\sqrt{\eta}$ is 3·46 per cent. greater than φ. Fig. 4 shows how the discrepancy changes with n. The ordinate for the full-line curve in that diagram is the discrepancy, namely, the excess of of $\sqrt{\eta}$ over φ expressed as a percentage of φ. This percentage will stand whether c_o is the adiabatic velocity or not. It may be of interest that if c_o is k times the adiabatic velocity, the velocity coefficient of the nozzle will be $k\sqrt{\frac{2n}{2n+1}}$ and the efficiency—

$$k^2\left[\frac{n-2}{n}+\frac{3(n+1)}{n(2n+1)}-\frac{n+1}{n(3n+1)}\right]$$

It will be remembered that the actual distribution in a fairly efficient nozzle approximates to that obtained with values of n of 8 and over. For $n=8$ the discrepancy between $\sqrt{\eta}$ and φ is 0·96 per cent. of φ.

The dotted curve of Fig. 4 shows the discrepancy between $\sqrt{\eta}$ and φ for an elementary circular nozzle with

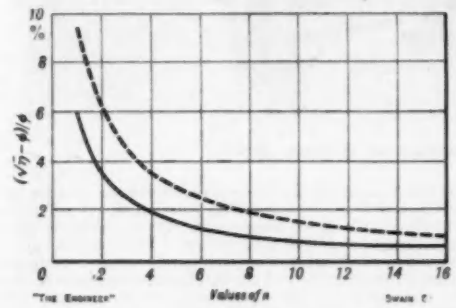


FIG. 4

the same velocity distribution across a diameter as is assumed across the rectangular nozzle already described.

As a second example a distribution of velocity is assumed which, in certain respects, approximates more nearly to experimental data than the previous one, and is shown by the simplified form in Fig. 5. In this case a nozzle is taken having a finite length, namely, 1in., and a width of 0·75in. The velocity is assumed constant and equal, say, to c_o over the whole of the middle of the nozzle up to within 0·05in. of the edge and to fall by a parabolic law $c=c_o(1-200\,x^2)$ to $\frac{1}{2}c_o$ at the edges. At each corner the velocity is taken as represented by a quarter of a paraboloid of revolution. Over the four little spandrils left at the corners it is $\frac{1}{2}c_o$. The following cases will be evaluated :—

Case (*a*).—As just given.

Case (*b*).—The velocity is allowed to fall to zero at the four edges of the outlet area by continuing the parabola along the dotted line, and for convenience increasing the size of nozzle by 0·02071in. all round as shown by the dotted line in the plan. The velocity in the four spandrils at the corners is now zero.

Case (*c*).—A different parabola is used, namely, $c=c_o(1-400\,x^2)$. The central area of constant velocity

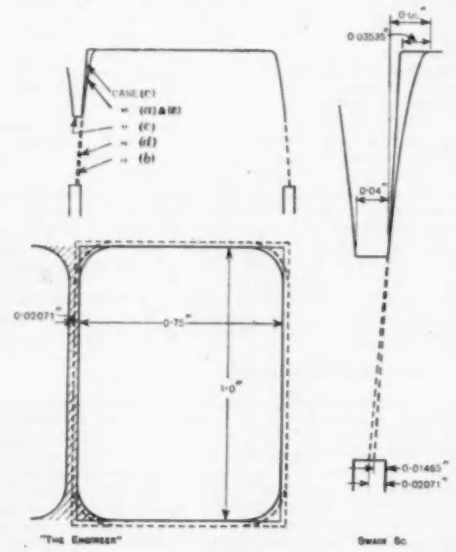


FIG. 5

is extended to within 0·3535in. of the boundary, where $c=\frac{1}{2}c_o$.

Case (*d*).—This is derived from Case (*c*) by continuing the parabola to where $c=0$ and increasing the size of the nozzle by 0·01465in. all round.

Case (*e*).—This is like case (*a*), but with the velocity maintained at $\frac{1}{2}c_o$ across an intervening strip 0·040in. wide, after which it rises parabolically for the next passage. The intervening strip has a shape shown shaded in plan in Fig. 5, and whether over a steam opening or not, is yet included as such for the purpose of integrating because fluid is actually running through it, as always happens with a series of turbine nozzles. In other words, case (*e*) merely assumes the pitch of successive nozzle passages to be 0·79in. There could, of course, be partitions 0·04in. thick, separating passages 0·75in. in length, but even if the partitions are filed very thin, leaving a steam opening practically equal to the pitch, 0·79in., a distribution of velocity very much as described can occur and would, as a matter of fact, be more likely with thin than with 0·04in. thick partitions.

Incidentally, all the above cases will apply to a jet inclined as in a turbine, but it is not necessary to consider the oblique picture, since vertical ordinates can represent inclined velocity so far as magnitude is concerned and, therefore, everything is catered for.

Results for these five cases are given in Table II.:

TABLE II.

Case	(*a*)	(*b*)	(*c*)	(*d*)	(*e*)
Velocity at boundary	$\frac{1}{2}c_o$	0	$\frac{1}{2}c_o$	0	$\frac{1}{2}c_o$
φ	0·9721	0·9560	0·9803	0·9692	0·9580
$\sqrt{\eta}$	0·9758	0·9647	0·9834	0·9757	0·9647
$(\sqrt{\eta}-\varphi)$	0·0037	0·0087	0·0031	0·0065	0·0067
$(\sqrt{\eta}-\varphi)/\varphi$, per cent.	0·38	0·91	0·32	0·67	0·70

It will be seen here, too, that with a lower velocity coefficient the difference between $\sqrt{\eta}$ and φ is greater.

Conclusion.—The velocity coefficient of a nozzle as given by an instrument giving an overall value from a measurement of momentum, is less than the square root of the efficiency if efficiency is defined as the ratio of the total kinetic energy of the stream to the adiabatic energy.

The amount of this discrepancy if expressed as a fraction or percentage of the velocity coefficient depends only on the type of velocity distribution and not on the velocity coefficient. Yet, as certain velocity coefficients are found by experiment to be associated with certain types of velocity distribution, it is possible to write down a series of values of the velocity coefficient and to give for each the order of the discrepancy to be expected, thus :

Velocity coefficient	1·00	0·98	0·96	0·94
Discrepancy $(\sqrt{\eta}-\varphi)/\varphi$, per cent.	0	0·3	0·6	0·9

SIXTY YEARS AGO.

Two great inventions and the tribulations and disputes which accompanied their introduction are recalled to the modern reader of our issue of June 30th, 1871. A Committee of the House of Commons was inquiring into the operation of the Patent Laws. It went into the fundamentals of the subject, for many people then, as some still do now, questioned the value of the whole system of granting patents and were desirous of seeing it abolished. Bessemer gave evidence before the Committee and described in detail the transactions which attended the development of his steel-making process. He stoutly supported the value of the patent system in spite of the fact that in connection with another of his inventions—the process for the production of bronze powder—he had preferred to rely on secrecy of manufacture rather than upon the protection which the Patent Laws could give. His father also was a "secret manufacturer," for without a patent he had for years worked a process for the recovery of metallic gold from the "colour water" used by jewellers. In the course of his evidence, Bessemer gave an account of the treatment he had received at the hands of Monsieur Schneider in France and of Herr Krupp in Germany in connection with the adoption of his process of steel making. According to his account, Monsieur Schneider was given a licence to work the process and received drawings and every other form of assistance towards establishing its operation. He did nothing, however, until fourteen months before the chief French patent expired, when he completed a large works for the manufacture of Bessemer steel. The works remained idle until the day after the patent expired. Thereupon the production of steel on an enormous scale was begun. As for his treatment by Herr Krupp, it would appear that Bessemer suffered more from the delays and prevarications of the Prussian Patent Office than from any questionable action on the part of the German steel manufacturer. Monsieur Schneider also figures in the second great invention. He had given evidence before the Committee on the Patent Laws and had recounted his story of the invention of the steam hammer. He took all the credit for that invention to himself, and virtually accused James Nasmyth of having copied his ideas. Nasmyth, writing from Penshurst, in Kent, addressed a letter to us on the subject, which we published in the issue quoted above. He turned the tables on Monsieur Schneider and asserted in perfectly plain terms that the French ironmaster had been guilty of distorting the truth and that it was he who had visited Nasmyth's works and had helped himself to Nasmyth's ideas and not the other way about. Mr. A. V. Newton, a patent agent of Chancery-lane, also wrote to us on the subject in order that Nasmyth's merits as an inventor and his character as a man of probity might not be made to suffer from Schneider's statements. We did not express any opinion on the truth of the matter, but contented ourselves by pointing out that Schneider's French patent for the steam hammer was dated April 19th, 1842. That date is favourable to Schneider's claims, for Nasmyth's first patent is dated June 9th, 1842. Nevertheless, we cannot judge the case entirely by patent dates. According to Nasmyth, Schneider visited Nasmyth's works in 1840 and was given every facility—in Nasmyth's absence—for studying his designs for a steam hammer. Nasmyth visited Schneider's works in 1842 and—in Schneider's absence—was shown the example of his own "thumping child," which by that time had been set to work at Creusot.

THE PERFORMANCE OF SINGLE-PHASE TRACTION MOTOR COMMUTATORS.

In the early days of main line electric traction with single-phase locomotives the commutators of the motors were regarded as one of the most sensitive parts. With certain types of motors they had to be overhauled after from 4000 to 5000 miles. The troubles were due to a large extent to the difficulties connected with the construction of commutators with comparatively large number of segments and a small width of segment, and were accentuated by the fact that, as a rule, commutators of locomotive motors are subjected to great variations in temperature. With the early designs deformations usually occurred after a certain period of operation, but, according to a recent issue of the *Bulletin Oerlikon*, issued by the Oerlikon Company, of Victoria House, Southampton-row, W.C. 1, these difficulties have been completely overcome. Particulars given of the performance of the motors of the Swiss Federal Railways are of interest.

The first case dealt with is that of the goods locomotives, series Ce 6/8 III. (1-C-C-1), some of which have been running, without any work being required on the commutators, since they were put into service some three to three and three-quarter years ago. During that time one locomotive covered about 287,000 locomotive miles.

Other locomotives referred to are the express locomotives, series Ae 4/7 (2-Do-1), supplied to the Swiss Federal Railways in 1928. Up to the end of October, 1930, the first of these locomotives had covered about 187,000 locomotive miles, also without any work having been required on the commutators. From the appearance of the commutator surface of these motors it is expected that as high a mileage will be obtained with these motors as that obtained with the motors of the Ce 6/8 III. class of engine. From these results it appears that a commutator that is correctly designed and carefully assembled should not be regarded as a more delicate part of a locomotive than any other component part of the electrical equipment.

American Engineering News.

Age of Machine Tools.

A SURVEY of the machine tool equipment in American metal-working plants discloses a wide range of average ages of the tools in works of different classes. Those with an age of ten years or more were classed as obsolete. Naturally, the works producing aircraft and aircraft parts have the lowest percentage of obsolete tools—only 4 per cent.—since that industry was in its infancy ten years ago. Taking old-established lines of industry, plants manufacturing bodies and parts of motor vehicles stand first with only 23 per cent. of obsolete tool equipment, while motor vehicle plants come next with 28 per cent. Then, in order, come the following :—Hydraulic mining and oil well machinery, 40 per cent.; pumps, fans and compressors, 42 ; jobbing shops and miscellaneous machinery works, 43 ; non-ferrous metal products, 44 ; electrical equipment, 46 ; food machinery, 46 ; paper and printing machinery works, 47 ; iron and steel products other than machinery, 47 ; engines and water wheels, 51 ; conveying and transmission apparatus, 51 ; construction or contractors' equipment, 52 ; foundries, 52 ; agricultural machinery, 55 ; woodworking machinery, 57 ; textile machinery, 62. At the bottom of the list come railroad repair shops and railway carriage and wagon works with 73 per cent. of obsolete machine tools, but they share this position and percentage with works producing cash registers, typewriters and calculating machines. For the entire list the average is 48 per cent. of tools ten or more years old, while of the 20 classes of industries listed, eleven have less and nine more than the average. In a geographical classification, the Pacific Coast—which is the newest in industrial development—stands first with only 37 per cent. of its equipment ten years old, while, in the old-established region of the North Atlantic States, the percentage is 63. In the great central region, including the states bordering on the Great Lakes, the percentage is 45. And it is interesting to note that 83 per cent. of the country's metal-working equipment is grouped within this region.

Natural-gas Engines.

Gas engine development in the United States suffered a decline after the World War period, owing to the rapid development in oil-engine design following the expiration of the Diesel patents. The producer-gas engine did not meet the competition, and gas engines have been utilised mainly where cheap fuel gas was available in large quantities, as at blast-furnaces and coke-oven plants. This situation has been changed materially by the rapid and widespread opening of oil resources and the simultaneous development of natural gas in fields of enormous capacity. With the discoveries of such vast quantities of cheap fuel, the gas engine took on new life, not only for power epuipment for the oil industry, but also for factory use, and irrigation pumping. There is still the old competition between four-stroke and two-stroke cycles, but the former is much the more generally used and only a few manufacturers specialise in engines of the two-stroke type. Horizontal engines represent 90 per cent. of the product. Double-acting engines, tandem engines and twin-tandem engines are built only on a small scale. In speed, various makes of engines range from 80 to 330 revolutions per minute, with piston speed usually 600ft. to 900ft. per minute, although some engines have been built for 1000ft. per minute. Gas consumption in engines of moderate size rarely exceeds 10,000 B.Th.U. per brake horse-power-hour under full load, with a thermal efficiency of 25·5 per cent. Higher records of 9000 or 8500 B.Th.U., or thermal efficiencies of 28 and 30 per cent., have been effected by giving ample combustion space free from pockets or large cooling surfaces, and improving various details, including gas-air mixing devices, sparking plugs and magnetos. In two-stroke cycle engines, complete combustion has been effected by so arranging the air ports as to obtain complete scavenging of the cylinder, and by injecting gas after the scavenging is completed—admitting it after the beginning of the compression stroke. As fuel economy depends largely upon the mixing device, various types and designs of mixers are being introduced.

AN exhibition of coal face machinery is to take place at the Edmond-road Drill Hall, Sheffield, from October 2nd to 10th, 1931. It is understood that most of the leading makers of coal face machinery will be represented.

BELT CONVEYOR FOR COAL

MAVOR AND COULSON, LTD., GLASGOW, ENGINEERS

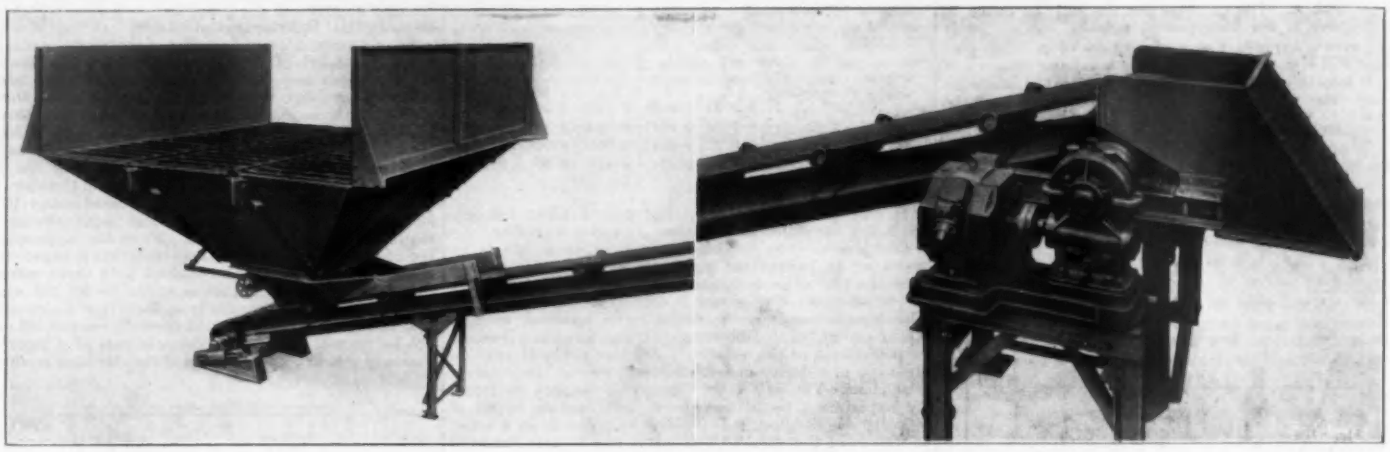


FIG. 1—RECEIVING HOPPER

FIG. 2—CONVEYOR DRIVING GEAR

A British Fuel-Handling Plant in Yugoslavia.

A FUEL-HANDLING plant made by Mavor and Coulson, Ltd., of Glasgow, has recently been installed at the generating station of Trepca Mines, Ltd., in Yugoslavia, about midway between Belgrade and Salonika. The power generated at this station, which contains a 1250 kW alternator, is used for driving adits, development work, mining, transport, crushing, concentration, lighting, and other purposes. The ore is lead zinc, averaging 11½ per cent. lead and 10½ per cent. zinc, some silver and a little gold. From the mine, 2500ft. above sea level, the ore is carried across mountainous country by an aerial ropeway, 4 miles long, to the crushing and concentrating plant on the railway beside the power-house. The mining plant was installed to mine and treat 500 tons of ore per day, but it has proved capable of dealing with from 600 to 700 tons. The concentrates are taken by rail to Salonika, a distance of 215 miles, and thence by ship to the smelters. A low-level adit, approximately 1½ miles long, is nearing completion, the average monthly rate of advance from May to September being 764ft.

The fuel-handling plant supplied by Mavor and Coulson is used for feeding the coal into the boiler-house bunkers, which have a total capacity of 80 tons, and which supply two Babcock and Wilcox boilers, each having a normal evaporating capacity of 12,000 lb. per hour. A general view of the conveyors and the elevator for feeding the bunkers is given in Fig. 3, whilst Fig. 1 gives a view of the grid receiving hopper into which the wagons discharge. A hand wheel controls a sliding gate, which regulates the flow of coal on to the 24in. belt conveyor, whilst special V side plates ensure central loading of the belt. The troughing idlers are carried on saddles, supported on inverted steel troughing, which forms a rigid light structure, and as the lower belt runs underneath this troughing, it is completely protected from spillage. The return idlers are carried by the brackets which join the sections of the inverted troughing, and are protected by a cover plate. At any time, the edges of the belt may be inspected at the return idlers, a condition necessary for training the belt. The idlers are turned all over and run on ball bearings; they are lubricated by a grease gun and hold enough lubricant for at least six months' operation.

The driving gear, which is shown in Fig. 2, has a single worm reduction running in oil, and, as shown in Fig. 3, the head pulley discharges to a crusher driven by a belt. From the crusher the coal falls to the foot of the elevator, which is of the belt and bucket type, the elevator belt being protected by a short length of belt inserted between it and each bucket. The driving gear is electrically operated through a single worm, running in oil. Between centres the elevator is 76ft. high, and at the top the coal is discharged centrifugally to an 11in. chain conveyor, conveying on the bottom run, which crosses the bunkers and discharges through one or other of four gates, the electric driving gear being situated at the far end of this conveyor. The fuel-handling plant, which has a capacity of 30 tons per hour, was put into operation in August of last year, and has given entire satisfaction.

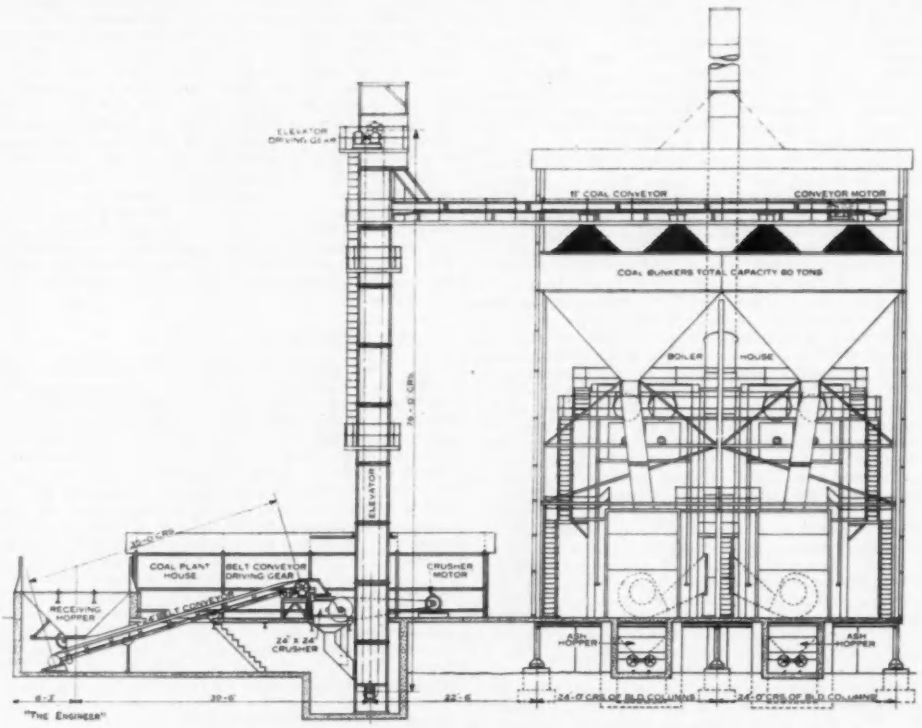


FIG. 3—GENERAL ARRANGEMENT OF CONVEYORS AND ELEVATOR

At a later date the chain conveyor will be extended to the right of Fig. 3, and will supply additional bunkers for other boilers.

South African Engineering Notes.

Victoria Falls Power Plant.

DURING April the Victoria Falls Transvaal Power Company, Ltd., set to work at its Vereeniging station a new turbo-generator, having a capacity of 32,500 kW. It is not sufficient, however, to meet the expanding need of the mining industry, and another set of similar capacity is now to be installed, together with boilers, which also will be of large capacity, probably capable of evaporating 100 tons of water per hour each. These sets are to meet the demand for electrical power, but, in addition, in order to meet the needs of the mines for compressed air, a new compressor station is being built at Canada Dam, near the Main Reef Mine. It will be set to work with three electrically driven compressors of an average of 24,000 horse-power. This station will be interconnected with the company's other compressor plant at Rosherville and the Robinson compressor stations by pipe lines of 27½in. diameter. The extensions, either just completed, in progress or contemplated, amount in the aggregate to 103,000 kW. The peak load on the company's network now reaches the large figure of 276,000 kW, or very nearly ten times greater than the maximum load demanded by the tramways, industrial and lighting services of the Johannesburg Municipality.

New Bridge Over Gouritz River.

When, in 1925, the South African Railways and Harbours Administration took over the line from Worcester to Forebay Junction, from the New Cape Central Railway Company, extensive work was undertaken to raise the standard to that of the main line. Heavier rails had to be laid and all the bridges and culverts either strengthened or replaced. This programme has now been completed, with the exception of the gap over the Gouritz River, where it was necessary to build an entirely new bridge, as the existing bridge could not be strengthened adequately to take main line engines running at speed. The total length of the new bridge will be 770ft. and the height of rail level above river bed level will be 210ft., while the total weight of steel work will be a little over 1500 tons. Each of the four legs of the trestles supporting the bridge will rest on concrete cylinders 18ft. in diameter. The most interesting feature of the construction concerns the erection of the steel work. The two western main spans were first built on rollers, with a 40ft. "launching truss," connecting the two, and a light 58ft. "erection truss" projecting from the span nearer the gorge. The whole mass—about 400 tons—was then rolled out over the gorge until seven of the eight panels of the western span were hanging in space beyond the Mossel Bay abutment. The time taken to launch the 150ft. length was 3 hours. This took place on January 8th of this year. During the second week in February, the second trestle was completed, and on February 16th, the cantilever was again rolled forward another 150ft. While perched on the two trestles the cantilever will be the means whereby the third trestle will be built. A final movement over 168ft. 9in. will bring the two main spans into their correct positions. Meanwhile, the other two main spans are being erected in the cutting on the east bank and, upon dismantling, the "launching truss" and "noses" of the present cantilever will be incorporated in the spans on shore, creating a cantilever which will then be launched into position over the gorge.

Railway Signals Change.

The entire signalling system at the Johannesburg railway station has been converted from mechanical to electric working, and the 55 mechanical semaphore signals have been replaced by red, green and yellow lights. These lights, as well as the power-operated points, are controlled from one signal cabin which has replaced the two necessary under the old system. The change-over necessitated the installation of 41 new signals, 29 shunt signals, and fittings for 73 sets of points. Seventy miles of cable were utilised in the layout. Under the new system there are increased safeguards in maintaining the necessary space interval between following trains. All train and engine movements are controlled by the 155 levers in the cabin. Johannesburg is the second Union railway centre to be equipped with this new method of colour-light signalling, it having been previously installed on the Cape Town suburban line.

Big Railway Schemes.

Some time ago, it became evident that the enormous increase in railway traffic at Cape Town was leading to congestion, and to combat it the Administration decided to remove the running sheds from Cape Town station to Salt River, as this step would not only bring immediate relief in the direction of locomotive working, but would also provide greater space and scope for improvements at Cape Town itself. The work was begun in 1927, and the fact that the scheme was estimated to cost approximately £250,000 indicates the magnitude of the undertaking. The site on which the new sheds are being erected is, to a large extent, reclaimed ground. This work included the dumping of 120,000 cubic yards of filling, the construc-

tion of 117,000 yards of levees to confine the Salt River, and the canalising of the river itself. The facilities provided at the Salt River are those usually found at a large locomotive depôt, and includes a modern engine shed and repair shop. Ash-handling and coaling facilities have been installed, and there is a reinforced concrete water tank with a capacity of 200,000 gallons. In the very near future, when the work is finally completed, the Administration will possess yet another modern locomotive depôt, bearing evidence of its progressive methods.

Table Bay Docks.

Operations on the new Southern Basin at Table Bay, which will provide a quayage of nearly 2500ft. and a sheltered water area of nearly 200 acres, are now sufficiently advanced to permit of the first berth with railway and shed facilities being placed in commission. The filling of the area between the South Arm and the New Wall has already entailed the depositing of 775,000 cubic yards of material. On this reclaimed area and its approaches 2½ miles of railway sidings have been laid. The new berth, with a length of 660ft., will provide a minimum depth of 25ft. at L.W.O.S.T., while the shed accommodation, constructed from the sheds on No. 3 and No. 4 berths, with new sides, roofs and floors will be nearly 500ft. long by 136ft. wide. The filling adjoining No. 2 berth is complete, and the quay surface and necessary railway tracks are being prepared. With regard to Berth No. 3, which will accommodate vessels with a draught of 36ft., and which, with dredging, will be able to take vessels drawing 40ft., filling is at present in progress. The Random mole, which encloses the basin on the south and south-east sides, is completed, with the exception of the entrance head. When these operations relating to what is known as the Modified South Arm are finished, a total of approximately 4½ miles of storage sidings and approaches will be available as well as 1½ miles of asphalted roads, the whole area being lit by floodlights. The total shed accommodation will amount to approximately 120,000 square feet.

Algoa Bay Pre-cooling Plant.

This year the Union expects to export about 2,000,000 cases of citrus fruit, an increase over last years' record figures of nearly 200,000 boxes. To meet the demands of Eastern Province fruit shippers, which are expected to amount to 500,000 cases, Algoa Bay has been equipped with a pre-cooling plant which will be ample for more than that quantity. During the last few years Algoa Bay (Port Elizabeth) has been carrying on with four refrigerated lighters, giving a total capacity of 560 tons. Last year a move was made to improve four wooden boats increasing the pre-cooling storage to 1000 tons, but these four boats were not insulated and were only justified as an emergency measure. This season there will be fully insulated cool-chamber lighterage, aggregating 2200 tons. Ten lighters have been specially fitted for fruit carriage, but while each will have its individual cooling unit, only the original four refrigerated cargo boats will have power units. The lighters range from 140 tons burden to 300 tons. Each has been given an inner skin of planking holding 7in. of insulating material right round the cool chamber. After, under the poop, is fitted a triplicate series of evaporating tubes enclosed in a galvanised steel casing, into which a ventilating fan of 30in. diameter is set. Except for a motor of 1½ H.P. for driving the fan, there are no mechanical fittings, such as usually surround refrigerating units. Instead, on the Dom Pedro jetty, there is being erected an English-built Haslam and Newton ammonia unit. The brine is brought down to freezing point and pumped along service pipes which will be extended for 300ft. along the breakwater on the inshore side. From these pipes flexible hose connections will be led off to the insulated lighters, which, after loading up with oranges or grape fruit, will be moored fore and aft. The fan motors will be plugged to electric connections ashore, and the brine circulated by the unit on the Dom Pedro jetty will pass through the cooling units with sufficient head to cool down 16 lighters fully laden. When the boats cast off for towage to the deep-water steamers, they will become merely floating insulated cool chambers, but while disconnected they will preserve a temperature of about 35 deg. Fah. for 24 hours or so, giving a margin of safety more than ample for off-loading.

A VEE LINK CHAIN BELT.

WE have just received some samples of a vee link belt for comparatively light power transmissions, made by Messrs. Fraser and Glass, of Woodside-lane, North Finchley, London, N. 12, which appears to have several merits.

It is built up of an ordinary cycle-type steel-link chain and a series of pads faced with leather for providing a grip in the V groove of a pulley. It is hardly necessary to point out that the connecting pins of such chains project slightly from the side plates, where they are riveted over. Advantage is taken of these projections for the attachment of the pads. The foundation of the pads is a U-shaped steel stamping, which embraces the chain. Each arm of the U has two perforations, which correspond with the rivets of the chain links. The stamping is sprung on to the chain and the engagement of the holes with the pin heads makes it secure. The stamping is flanged round the edges and into these flanges there are pressed wedge-shaped pads of leather, tapered to suit the groove of the pulley. These pads form the gripping surface for the belt.

It is obvious that the belt will have little stretch on account of its steel foundation, and should run smoothly at high speeds—some belts are actually running at speeds as high as 5670ft. per minute. The belt also has the advantage that it can be used for very high ratios of speed reduction, as, in the event of the leather pads not providing sufficient grip on the smaller pulley to transmit the drive, the links of the foundation chain can be engaged with the teeth of a sprocket instead. It is, however, claimed by the inventor that so long as three pads of the belt are in engagement with the pulley the full permissible power transmission of the belt can be maintained. The chain is made in a dozen different sizes, ranging in width from ⅛in. up to 1¼in.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

An Uneventful Week.

THERE has been no development of note in the industrial position in the Midlands and Staffordshire during the past week. Activity at the engineering and manufacturing works has not improved and the recent dull conditions ruling on the iron and steel market in Birmingham are unrelieved. The persistence of the trade depression in this area is badly shaking the belief of industrialists in the ability of the situation to right itself, and confidence in the future is much less in evidence than it was some short while ago. In hardly any of the important branches of Midland trade are substantial order books to be found, and managements have the greatest difficulty in finding three days' work per week for their employees. No positive forward movement is considered likely to take effect now until the arrival of the normal seasonal trade advancement associated with the autumn. The increase of uneasiness and want of confidence make it no easy matter for the different iron and steel bodies to maintain fixed selling prices. Neither in finished steel nor in raw iron has there so far been any breaking away from the agreed price levels, but the present crisis is undoubtedly making a heavy demand upon the loyalty of the associated firms. In branches of the iron and steel trade where there is no control over selling rates, prices are gradually weakening, and in some instances they are substantially lower than they were a month or so ago. Consumptive demand in all departments is weak and producers of material, fearful of further increasing their at present heavy stocks, would, no doubt, be willing to accept lower terms than those now ruling had they a free hand. The instability of prices of uncontrolled materials continues.

Steel.

In the steel trade there is no visible movement from the dull conditions which have prevailed for some months. Specifications for all heavy material such as joists, plates and large sections are small and irregular. Consuming engineers are generally short of contracts, and the tonnage of finished steel being used in this area is, in the aggregate, not heavy. The Steel Masters' Association firmly controls prices, and although some firms believe that they could do business if they were in a position to grant concessions, they are, so far, standing firm by the Association levels. It is some consolation to them to know that continental competitors find it as difficult to get business from this district as they do. On 'Change in Birmingham this week the small amount of business put through was transacted at the following minimum rates:—Angles, £8 7s. 6d., less 15s. rebate; tees, £9 7s. 6d., less 15s.; joists, £8 15s., less 22s. 6d.; ship, bridge and tank plates, £8 17s. 6d., less 15s.; boiler plates, £9. In the half-products branch keenness to secure orders leads to the cutting of prices; indeed, it is stated that some producers with a large range of output regard prices obtainable for steel semis as a secondary consideration. They are said to be relying for their earnings on the saving effected by the regular running of the plant as a whole. Be this as it may, a figure in the region of £6 7s. 6d. per ton has been accepted for small re-rolled bars. Staffordshire re-rollers of continental material for the most part quote £6 10s., and for all-British bars £7. Mild steel billets of native manufacture are sold at from £5 upwards, and Staffordshire hoops at £9 10s. Continental material is still being sold at very low prices, but merchants are less pushing than previously. It is thought that continental manufacturers have secured some standby of orders and are now hoping for an expansion of demand in the near future, which would enable them to raise the level of prices. Imported steel bars are, at date, worth about £4 2s. 6d. and billets £4. It is practically impossible, however, to give a definite price level for continental material.

Pig Iron.

Midland blast-furnacemen continue production at about recent rates. There is very little variation from week to week in the tonnage of foundry and forge iron distributed to works in this district. Orders continue on the small side and forward contracting is regarded by users as out of the question in the present state of trade. Stocks at Midland furnaces are large, but they are not being added to appreciably. Foundrymen in Staffordshire report business very quiet for the time of the year, while forgemen are very poorly employed. Prices of raw iron are on the basis of £3 2s. 6d. for Northamptonshire No. 3 foundry, and £2 17s. 6d. for forge, £3 6s. for Derbyshire and North Staffordshire No. 3 foundry, and £3 1s. for forge material, all per ton delivered to stations in the Black Country and subject to rebate. Furnacemen are just now fortunate in being able to obtain coke at rather low levels. The market is generally easy and contracts could probably be arranged at somewhere round 11s. per ton. Good furnace coke has this week been purchased at 10s. to 11s. per ton, while rumour has it that spot lots are to be had at even lower prices. Northamptonshire blast-furnacemen do not appear to be doing quite so much business in Northern markets as they were.

Finished Iron.

There is no improvement in business in the Staffordshire wrought iron trade and activity at the mills is intermittent. The average working week does not much exceed three days. Orders are as difficult to secure as ever, most difficulty being experienced by makers of Crown bars and of common bars. Iron strip mills have done a little better since they reduced prices, but the inflow of work has not come up to expectations. Staffordshire marked bars command the full £12 per ton asked for them by makers, but Crown bars vary considerably. The minimum for this quality bar is about £9 5s. Nut and bolt and fencing bars make £8 10s., and wrought iron gas tube strip £10 12s. 6d. delivered.

Galvanised Sheets.

Galvanised sheet prices are still unsteady, the minimum figure acceptable having fallen on the week by half-a-crown, making it £9 17s. 6d. Many makers want upwards of £10, but few would now refuse £10 per ton for a good order for 24-gauge corrugateds. There have been some inquiries this week from South Africa, South America and the West Indies, but they have not as yet had time to develop, and they do not refer to big scale business. Demand from home sources is maintained and reaches a fair average. There is no marked alteration in other classes of sheets.

Scrap.

The stagnation in the steel scrap market persists and values are very weak. Heavy steel scrap was on offer in Birmingham this week at 30s.

Omnibus Order.

An order has been placed by the Birmingham Corporation with Morris Commercial Cars, Ltd., of Birmingham, for ten 34-seater single-deck motor omnibuses.

Unemployment.

The improvement in the employment position in the Midlands recorded last week has been more than nullified by a subsequent increase in the number of unemployed of 3139, bringing the total for the area to 386,504. The present total is higher by 121,624 than it was at the corresponding period last year. The Birmingham figures are 67,698 and Stoke-on-Trent 37,472.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

£6,000,000 Dee Bridge Scheme.

EARLIER this month it was recorded here that the Unemployment Sub-committee of the Liverpool Corporation Finance Committee had decided to forward an amplified report to the Ministry of Transport on the scheme, estimated to cost £6,000,000, for shortening the journey between Liverpool and North Wales by about 30 miles by means of an embankment and bridge, 4 miles in length, extending from Hoylake, on the Cheshire bank of the river Dee, to Point of Air, on the North Wales coast. At present a long detour up the river and through Chester has to be made, and definite economic advantages, especially to Liverpool and district, would obviously result if the scheme were adopted and put into operation. Moreover, it is urged by its sponsors that a fuller development of Wales's resources in coal, copper, lead, and limestone would be rendered possible. The scheme has been further considered at a meeting of the Liverpool branch of the Industrial Transport Association, and a resolution passed pressing for an inquiry to be carried out by the Ministry of Transport.

Copper Users' Serious Problem.

The restrictive effect of the activities of the American Copper Exporters' Association was discussed by Mr. Leonard Sumner, chairman of directors, at the annual meeting in Manchester of the Broughton Copper Company, Ltd. For the year to the end of March last the company's operations resulted in a net loss of £35,608, compared with a net profit of £14,660 in the previous twelve months, and Mr. Sumner attributes much of the blame for the loss to the Copper Exporters' Association. Whenever there was a slight buying movement, he said, the Association limited the quantity it was prepared to sell, and instead of helping trade it had strangled such trade as there was, hurting itself considerably in the process, as well as inflicting serious injury upon industrial consumers of the metal. If the Association had followed the market and allowed the laws of supply and demand to operate prices would have adjusted themselves, and the past year's results of the Broughton Copper Company would have been quite different. Mr. Sumner attributed the company's losses as being due in part to the continuous, but more particularly to the erratic drops in price sponsored by the Association. It was announced that Engineer Vice-Admiral Sir Robert Dixon will join the board of the company, and that the services of Dr. Walter Rosenhain have been secured as consultant and metallurgical adviser.

Industrial Results.

The report of the directors of Platt Brothers and Co., Ltd., textile machinery manufacturers, of Oldham, states that during the year to the end of March there has been little demand for textile machinery, and that the company had been very short of work throughout the period. After writing £44,834 off patents, the accounts show a net loss of £137,966, against a profit of £25,281 in the previous year. The preference dividends have been passed, and no distribution on the ordinary share capital has been made since 1926–27. A loss of £10,478 has been sustained by Royce, Ltd., electrical and mechanical engineers, of Trafford Park, Manchester, for the year ended March last.

Non-ferrous Metals.

All of the non-ferrous metals are substantially dearer at the moment of writing than they were a week ago, and there is a growing hope that at last the bottom of the price decline has been reached. The markets have not been entirely free from erratic price movements, however, the renewal of strength being due more than anything else to the optimism engendered by Mr. Hoover's

war debt proposals over the week-end. The statistical position in respect of tin is still the reverse of strong, and stocks of the metal are in excess of the demand. In spite of that, however, there has been a net gain of about £7 a ton. Copper has advanced to the extent of about £3 a ton compared with a week ago, and here, again, the recovery has been due less to any real improvement in the position of the metal than to a renewal of "bullish" sentiment. The demand for both lead and spelter has only been moderate, but the former is dearer by nearly £2 a ton and the latter by about £1 7s. 6d. If the metals are able to resist any serious reaction, there seems to be a reasonable prospect of the markets extricating themselves from the depression which has lasted so long. It only remains to be said that the past week's substantial gains have brought tin quotations higher than they have been since late in April, copper back to the level prevailing at the end of May, and lead and spelter to the prices ruling in mid-March.

Iron and Steel.

So far as actual business conditions are concerned, neither iron nor steel on this market has experienced any improvement, although in a quiet way sentiment seems to be rather more hopeful. Occasionally one hears of foundries buying pig iron for delivery over the next four to six weeks, but that is by no means general, and in the aggregate the tonnage moving into consumption in this part of the country leaves much to be desired. The principal irons are held at last week's levels, Cleveland, Derbyshire and Staffordshire brands being quoted at 67s. per ton for delivery equal to Manchester, and Northamptonshire at 65s. 6d. The demand for Scottish iron is very poor indeed, and at a top figure of 87s. 6d. per ton, delivered Manchester, values are inclined to sag. Lancashire bar iron makers have maintained prices at the recently reduced levels, but business in this section is no better than before, individual orders being for very small quantities. Crown bars are quoted at £9 15s. per ton, and No. 2 material at about £8 5s. Steel rollers are receiving very little buying support on the Lancashire market, and if the position of consumers has not actually worsened, it is certainly no better, more especially among constructional engineers. The only price movement of any consequence in the steel section has been the reduction of small re-rolled bars to £6 10s. per ton, supplies being obtainable at between this figure and £6 5s., according to quantity. Sales of imported products here have been of limited extent, but the fact that Germany has secured substantial orders from Russia has served to strengthen the undertone of the Manchester market during the past week, and semi-finished materials have moved up a little.

Competition in the Oil Engine Industry.

In the course of his remarks to the shareholders of Mirrlees, Bickerton and Day, Ltd., at the annual meeting held on Tuesday last in Manchester, Mr. Charles Day, chairman, said that few other branches of engineering had attracted so much attention during the last dozen years as oil engine building, and that in the future mass production methods will come into the trade to a much greater extent than hitherto. He said that during the year this firm had completed amongst other orders two 1300 B.H.P. engines for the Broken Hill Mines, Australia, and since then had built a third engine for the same company; while a fourth was near completion. These engines are to drive direct connected air compressors, and the compressing sets will be the largest in the world. Two 1200 B.H.P. two-stroke cycle engines had also been supplied to the Buenos Aires and Pacific Railway Company. The new high-speed engine which was tested a year ago and was exhibited at Buenos Aires had given very satisfactory results. Referring to the sugar machinery side of the business, Mr. Day said that the production of sugar had for some years been unprofitable, as the production had exceeded the demand, but recently an agreement had been arrived at between the sugar-growing countries to reduce production systematically. This, he considered, would have a beneficial influence, and already the orders secured for sugar machinery during the first two months of this year were substantially greater than for the corresponding period last year. The largest pumping plant built by this company last year was for the London County Council. Speaking of the industry as a whole, Mr. Day referred to the fixed charges in engineering works, which, he said, represented about 20 per cent. of the total manufacturing cost, and some firms were accepting orders down to 20 per cent. below the real cost—a dangerous course, and one which quickly led to a general drop in prices, from which recovery was not easy. Knowing the difficulty which will be found in restoring prices, his company was paying special attention to the reduction of costs of production while retaining a high standard of quality. Although the financial position of Mirrlees, Bickerton and Day, Ltd., was considered extremely sound, it was not considered desirable to pay a dividend this year on the ordinary share capital, and the carry forward was slightly increased.

BARROW-IN-FURNESS.

Hematite.

The condition of the hematite pig iron market is unchanged. Buyers are not taking any more than their immediate requirements demand. The Midlands are taking the most, while the Scottish and Welsh business continues to be thin. Makers are not booking any orders for forward delivery to speak of, there being no necessity to do so, in view of the heavy stocks which still exist. Pig iron at present is certainly being sold at a loss of several shillings per ton, but producers find it is better to sell at such a loss than to close down, having still to meet establishment charges, &c. The furnaces at Barrow are still damped down, and as a result stocks are being reduced. There is only one furnace at work at Ulverston. Millom has two. The furnace at Backbarrow, which produces high-grade iron, is idle at present, owing to stocks having accumulated. Iron ore is dull, both local and foreign. The steel trade is also dull, and while there are prospects of fresh contracts for rails, &c., there is no sign of re-starting at present. Hoops are being rolled at Barrow and also high-grade bars for motor springs, &c.

SHEFFIELD.

(From our own Correspondent.)

A Quiet Time.

THIS is the quiet season for the iron and steel trades, and many people in Sheffield are finding it very quiet indeed. The firms which are able to take a really cheerful view of the situation are terribly in the minority, and it is generally agreed that conditions have become worse during the past few weeks. It is good to read, however, that the proposed reparations holiday is likely to have a beneficial effect on trades such as are carried on in Sheffield, but that is at present very much in the future. The existing state of things is more inclined to inspire pessimism than optimism, and any bright gleam on the horizon would be cordially welcomed. The depression in the heavy steel branches is accentuated by stoppages for stocktaking at various works. The whole of the great establishment of Steel, Peech, and Tozer has been set down throughout this week, and it is not certain to resume at the beginning of next week unless orders come in more freely than has been the case recently.

Manufacturing Departments.

It is not only in heavy and crude steel that trade is exceptionally bad. There are few manufacturing departments which can show a much better state of things. Railway work is still extremely scarce, but there is a fair amount of work on hand in connection with the hollow forging of heavy drums. The call for shipbuilding steel remains very poor. Perhaps the healthiest department is still that concerned with the production of stainless steel and kindred materials. The largest electric steel-melting furnace in the country, which was installed some time ago at the works of Thos. Firth and John Brown, Ltd., is now fully at work, exclusively on the production of special steels of the stainless type, and it will probably continue on full time henceforward. It has a capacity of 20 tons. The purchase of such a plant indicates the important part which stainless steel is playing in local industry. There is a less satisfactory report to give of the branches producing stampings, pressings, and special steel for motor car work. Sheffield has for a considerable time been supplying large quantities of these products to the automobile industry, and, while a good output is still maintained, there has been a serious shrinkage during the last two years, and the process continues. In best tool steels the depression is acute, and leading firms state that the present shortage of work is unprecedented. The demand for engineers' tools from the home market is moderate, but export trade has dwindled to very small proportions.

John Brown and Co.'s Report.

A review of conditions in the heavy trades during the past year is contained in the annual report for the twelve months ended March 31st of John Brown and Co., Ltd. The directors state that "there has been a steady decline in all the principal branches of trade, such as shipbuilding, collieries, and the heavy steel industry, in which the company is or has been interested, and at the present there is little or no sign of improvement. The general outlook in the shipbuilding industry is far from satisfactory at present, and there is an unprecedented dearth of new orders for warships and mercantile vessels." The accounts show a balance of profit of £10,531, but that does not permit the payment of any dividends to preference or ordinary shareholders. Browns have recently, of course, amalgamated their steel undertaking with Thos. Firth and Sons, Ltd., and the directors express the belief that this amalgamation will give effect to a measure of true rationalisation, which, when complete, will achieve very important economies, and at the same time increase efficiency.

More Reports.

Several local companies have issued their reports during the past week, but, with one exception, they have a poor or bad story to tell. Thos. Firth and Sons, whose report covers the year 1930, made a net profit of only £25,902, as compared with £126,090 in 1929. Edgar Allen and Co., Ltd., has been so adversely affected by the severe depression in the steel and engineering industries, that for the first time since 1923 a loss has resulted from the year's working, that loss being no less than £34,775. Darwins, Ltd., report a loss for the year of £18,116. Marshall, Sons and Co., Ltd., engineers, of Gainsborough, have to report a loss of £49,843, or, with the interest on debentures, £66,866. The bright exception in this depressing catalogue is the report of the Stanton Ironworks Company, which shows a profit of £264,193, an increase of £23,500 on the previous period. The dividend is maintained at 10 per cent. tax free. The company's plant for making centrifugal iron pipes has been operating at high pressure throughout the year, and an extension for doubling the output of various dimensions is now in operation. Various other improvements have also been made. It is also stated that the new colliery at Bilsthorpe is gradually increasing its output, but, on the other hand, the operations of the three remaining collieries are seriously restricted by the working of the Coal Mines Act.

Horseshoes and Wire Ropes.

William Cooke and Co., Ltd., of the Tinsley Steel, Iron and Wire Rope Works, Sheffield, are making favourable progress towards recovery. Owing to trade depression, they had to close down their bar mills and wrought iron departments some time ago, and confine themselves to the manufacture of horseshoes and wire ropes. They made a small net profit last year, but they still have a heavy debit balance, and also abnormal depreciation to write off. At the annual meeting last week the chairman said that the gross profit for the year was very much the same as in the previous year, although the turnover in money was only about half as much. Horseshoes showed an increased tonnage of nearly 10 per cent., and the amount received for their sale showed a corresponding increase. In wire ropes the home sales showed a very small increase in tonnage, and the export sales a decrease, but the net decrease was under 5 per cent. In money the sale of wire ropes showed an increase of about 5 per cent., owing to the fact that better prices were obtained.

Government Orders.

Several Sheffield and district firms are sharing in the latest orders given out by different Government Departments. The Admiralty has ordered expanders and tube rollers from Easterbrook, Allcard and Co., Ltd., Joseph Evans and Sons, Ltd., and Pearson and Co. (Chesterfield), Ltd. Engineers' and shipbuilders' tools for the same Department are being obtained from J. Bedford and Sons, Ltd., Joseph Evans and Sons, Ltd., Hale Brothers, Ltd., Moore and Wright, Osborn and Co., Ltd., and J. Robson and Sons. The War Office has placed orders for steel billets with the English Steel Corporation, Ltd., and for round steel with S. Fox and Co., Ltd., Hadfields, Ltd., and the Park Gate Iron and Steel Company Ltd. The Air Ministry is taking empty bombs from Hadfields, Ltd., and steel wire from John Shaw, Ltd.

A Steel Expert's Retirement.

Mr. G. G. Coppel, managing director of J. J. Saville and Co., Ltd., Triumph Steel Works, Sheffield, and of William Jessop and Sons, Ltd., Sheffield, who is retiring from business, has played a very distinguished part in building up Sheffield's renown abroad for high-speed tool steel and other quality steels. He has been associated with J. J. Saville and Co. for more than fifty years, and the production of several of that firm's best known brands of high-speed steel was the result of his personal activities. His knowledge of foreign trade is regarded as unique. He has travelled extensively in foreign countries, and succeeded in establishing important trade connections for his firm abroad. There is no greater authority in Sheffield on tool steel manufacture and marketing methods abroad. The fifty years' record of J. J. Saville and Co. forms an important and interesting chapter in the history of one of the most considerable sections of Sheffield's steel industry.

An Engineers' Tool Purchase.

Mr. William Brookes, proprietor of the firm of W. Brookes and Sons, engineers' tool makers, Howard Works, Woodbourn-road, Sheffield, has purchased the premises and business of Joseph Evans and Sons, Ltd., Highfield Tool and Steel Works, Heeley, Sheffield. Both firms are old and well known. That of Brookes dates from 1774 and was the pioneer firm in the engineers' tool trade of Sheffield, which it took up over 100 years ago, in the early days of railway construction in this country. The firm of Evans has been established some fifty or sixty years. Mr. Brookes is leaving Woodbourn-road, and concentrating the whole of his business at Heeley, where the works cover about 2 acres, with room for extension, and are equipped with modern plant. He manufactures a great variety of engineers' tools, his customers including Government Departments, corporations, and the principal home and foreign railways. Owing to the depressed state of trade, the works at present are only employed up to about half capacity, but there are quite a number of good orders on hand, which enable full-time work to be found for the men actually employed, and since operations were transferred to Heeley, Mr. Brookes has found it possible each week to provide additional work for men who had been suspended.

Royal Tribute to Sheffield Steel.

Daimler Motors, Ltd., which has just delivered cars to the King, has received from His Majesty's equerry a letter conveying special thanks for the excellence of the vehicles, together with a request that all who took part in the work should be notified of the King's satisfaction. This expression includes a tribute to Sheffield and its workmen, for special steel used in the cars was manufactured by William Jessop and Sons, Ltd., of Brightside. That firm has had a copy of the King's letter delivered to all their workmen who were concerned in the work.

Cutlery and Plate.

There is little improvement to report in the home trade of these departments. While catering firms continue to send in good orders, there is less doing with shipping companies, and the seasonal sales to holiday houses are below the normal. Sales through ordinary shopkeeping channels are still on a limited scale. There has, however, been an improvement in the export trade, the figures for May showing an advance of £13,000 on April. Purchases by Australia, which have been at a very low level for the past year, made welcome progress, amounting to double the value of the previous month's, and there were also gains in America and New Zealand. The value of safety razors and blades sold abroad showed a substantial improvement. Imports of cutlery during May were valued at £41,414, compared with £37,639 in April. For the first five months of this year the import figures were £75,000 more than for the corresponding period of last year, but £40,000 less than in 1929.

NORTH OF ENGLAND.

(From our own Correspondent.)

Dullness Continues.

THE state of quietness in nearly all branches of industry in the North of England continues. A slightly better tone, however, has permeated the commodity markets. That is probably due to the influence of the Hoover plan. While there is no disposition to attach exaggerated hopes to the American President's proposals, it is, nevertheless, recognised that the general rise in the commodity and security markets cannot fail to influence all branches of industry and commerce favourably. Certainly North of England industries, particularly the iron and steel trade, are urgently in need of a stimulus. At the present time, more iron is being produced than is

being sold, and at some of the works stocks have reached large dimensions. That is not very comforting, more especially in view of the fact that foreign producers are once more pressing sales in the area. Unless there is an improvement in the early future, a further restriction of output appears to be inevitable. An unfortunate feature of the situation in the iron and steel industry is that in recent weeks work in the steel departments has fallen off considerably, and iron which normally would have gone for conversion is going into stock to some extent.

Cleveland Iron Trade.

Little improvement is reported in the Cleveland pig iron trade. The statistical state of the trade is causing uneasiness. Stocks are steadily increasing. Further purchases of Midland iron for consumption in the North of England are reported. Restricted output of iron in the Cleveland district is in excess of requirements, but certain pig iron consumers here, who have to purchase iron, are buying in the cheapest market, and resumption of acceptance of overseas iron by Tees-side firms would cause little surprise. Producers offer Cleveland iron to Scotland at very low prices, but continue to be undersold there by dealers in continental and Indian iron. Export business is negligible. For home purposes makers adhere to the following fixed figures:—No. 1 Cleveland foundry iron, 61s.; No. 3 G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d., and No. 4 forge, 57s.

Hematite Pig Iron.

East Coast hematite is now cheap compared with rates ruling for Cleveland pig iron, but values show further downward tendency. Business is quiet. Merchants are not hesitating to cut prices to secure any small foreign orders which may be offered, but home needs appear to be fairly well covered, and sales are confined to small prompt lots. Ordinary qualities are now in the neighbourhood of 62s. 6d., or only 4s. above the recognised value of No. 3 Cleveland iron, whereas the normal difference prior to the war was 8s. to 10s. Accumulations of hematite are very heavy at certain makers' works.

Ironmaking Materials.

The foreign ore trade is inactive. With consumers well placed as regards supplies and almost confining operations to purchase of odd cargoes at bargain prices, values are difficult to fix. The nominal price of best Rubio ore is 15s. c.i.f. Tees. Demand for blast-furnace coke keeps quiet. For early delivery to consumers in this area, good average qualities are obtainable at 15s. 3d., but forward contracts could not be arranged except on substantially higher terms.

Manufactured Iron and Steel.

The outlook in the manufactured iron and steel trade is discouraging. A general falling off in business was experienced at the beginning of the quarter, and from it there has not yet been a recovery, with the result that in the heavy departments, and in regard to rolled steel of ordinary descriptions, inquiries are few and unimportant, and much of the business is of a hand-to-mouth character. Constructional steel sections keep fairly busy on contracts placed some time ago, and departments producing railway material have still a fair amount of work to complete, but all other departments of the industry are in urgent need of orders. Fixed steel prices are due for revision next month.

Wear Shipyard Closing Down.

Another Wear shipyard, that of J. L. Thompson and Sons, Ltd., North Sands, Monkwearmouth, is temporarily closing down until the shipbuilding trade revives. In the event of any orders being booked, the yard, one of the most up-to-date on the river, will at once re-open. It is nearly a year since the last vessel was launched from the yard.

The Coal Trade.

Buyers in all sections of the Northern coal trade appear to have covered their requirements for this month, and the curtailed outputs in both Northumberland and Durham, owing to this week's annual holidays, have had no effect on the market tone. Pits were booked up for their present range of output at the beginning of the month, but could readily arrange to supply any additional quantity required. For July the position is quiet, and operators are wondering where business will come from to absorb the output. There does not seem to be any sign of expansion of demand; the tendency is rather the other way. For small parcels holders expect to be able to command some slight appreciation, but the general conditions of the market do not give any encouragement to a prospective stronger range of values. Best Northumberland steam coals are offered at recent values for any prompt or forward position. Best qualities are 13s. 6d., and seconds 12s. The Durham coal trade outlook is very dull. The seasonal demand is much below the ordinary spring period and inquiries for summer delivery are very scarce. Contractors under old bookings are only earmarking minimum commitments, and new business is practically not in evidence. Special Wear gas are obtainable at 15s., and other good qualities at 14s. 6d. Secondary gas are abundant, despite short-time working at the pits, and offer readily at 13s. 6d. Durham coking unscreened are a slow trade at 13s. to 13s. 3d. The demand for best descriptions of bunker coal keeps up to the recent level, and prices remain unchanged, remaining at 13s. 6d. to 13s. 9d. Secondary bunkers are in dull demand and easy at 13s. 3d. There is very little inquiry for coke, and values are nominal.

SCOTLAND.

(From our own Correspondent.)

Dull Conditions.

BUSINESS in the steel, iron and coal trades is very lethargic. Markets generally are depressed, all efforts to improve the situation having been of no avail. Lack of purchasing power at home and keen competition abroad, which is becoming ever more widespread, embracing markets hitherto almost free of competitive products, have made progress increasingly difficult. It was anticipated that India and South America would ere this be again buying in considerable quantity, but developments are extremely slow and the presence of competitors is more apparent. Australian demands are of small account meantime. The weakness of continental iron and steel and stern competition from the coalfields in Poland continue to present almost unsurmountable difficulties. Markets have a most depressed appearance and there is no reason to anticipate an early improvement.

Steel.

While there has not been any general improvement in the steel market, inquiries have been a shade more numerous, which may bear fruit. Recently, one or two firms have received sufficient orders to enable them to increase production, but these orders will hardly do more than balance the reduction of output by other concerns. The Steel Company of Scotland will benefit from the order received by Messrs. Yarrow to build torpedo-boat destroyers for the Portuguese Government, and tube makers in the West of Scotland hope to secure an important contract for the East. Apart from these items nothing of interest has occurred. Steel works, as a rule, are employed far below capacity owing to the depression in the shipbuilding industry, and lack of export orders. Plates and sections are very dull. Sheet makers have a little business on hand, but the growth is very slow, especially in galvanised sheets, despite a further reduction in price to £11 7s. 6d. home, and £10 10s. per ton for galvanised corrugated sheets 24-gauge. At present tube works are working on alternate weeks. Scrap material shows further weakness, cast iron machinery being now 49s. 3d. and heavy steel 37s. 6d. per ton.

Manufactured Copper Reduced.

A reduction of £3 per ton has been made in the price of manufactured copper, making the basis price £67 per ton.

Iron.

Bar iron makers make little progress. Consumers at home, as a rule, prefer steel, owing to cost, and export markets have responded as usual. Re-rolled steel bars at £6 5s. home and £6 2s. 6d. export suffer in competition with continental material at £3 7s. to £3 8s. per ton f.o.b. Antwerp.

Pig Iron.

A scarcity of orders and continued imports from abroad leave home producers of pig iron little chance of expansion. During the week another cargo of 2000 tons was unloaded at Glasgow harbour. Shipments last week amounted to 105 tons—35 tons foreign—compared with 50 tons—10 tons foreign—in the same week last year.

Coal.

Outputs of Scottish coal are still greatly curtailed, but prompt supplies of all qualities of round fuels are plentiful. Collieries in Fifeshire endeavour to maintain the price of best steams, but quotations of all other descriptions of round coals tend to decline. Owing to shortage washed units in all districts are firmer. Aggregate shipments amounted to 216,802 tons, against 177,292 tons in the preceding week, and 232,258 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

EXTREMELY quiet conditions continue in evidence in the steam coal trade, and this fact is borne out by the returns of recent shipments. Last week the total, according to the figures issued by the G.W.R. Company, for the six ports in this district under its control came to 444,100 tons, which compared with 485,400 tons for the preceding week and with 541,968 tons for the corresponding period of last year. As a matter of fact, the loading position finished up very badly, inasmuch as on Saturday there were as many as forty-seven idle tipping appliances at the various docks. The situation this week is not a great deal better, as arrivals of tonnage over the week-end only meant that the number of idle appliances on Tuesday was reduced to thirty-five, which is far from satisfactory and wholly inadequate to meet the requirements of collieries. The demand generally shows no improvement, though there is naturally some speculation as to whether the coal industry of this district will benefit in the event of the Hoover proposals for the postponement of war debts and reparations becoming effective. It is, of course, too early to form any opinion on the question, though it is believed that while eventually the coal industry would feel beneficial effects, the fact remains that through overproduction and under-consumption it must inevitably be some considerable time before the coal trade can really revive. The current inquiry for coals is restricted to foreign consumers' barest requirements, and it may be that the uncertainty prevailing in this country regarding the question of working hours in the coal mines is prejudicially affecting operations. Foreign buyers know full well that in the event of trouble arising from a failure to reach a settlement they can easily secure all the coals they require from continental coalfields at prices which are very attractive. At the moment there is no business of any material account on the market outside the Egyptian State Railways' requirements of 100,000 or 200,000 metric tons of locomotive coals for delivery over a period of four months, for which tenders are to be opened at Cairo on the 30th inst.

The Navy and Coal.

At a recent meeting of the committee dealing with the "back to coal" movement in the Navy, the draft of the petition which is to be submitted to the Admiralty was, with a few minor alterations, approved. Since then a letter has been received from the Admiralty agreeing to meet a deputation from South Wales on Wednesday, July 1st. A strong and representative deputation has already been appointed, including the Lord Mayor of Cardiff, the chairmen of various Councils, and a number of leading men in industry.

Trade of South Wales.

The latest statistics issued by the Great Western Railway Company of trade at the six ports in this district under its control for the four weeks ended June 7th do not afford very pleasant reading, as there is again a decline. Imports and exports totalled 2,237,900 tons, which compared with 2,389,191 tons for the preceding month and with 2,783,371 tons for the corresponding period in 1930. For the whole of this year to June 7th, the aggregate of imports and exports amounted to 11,883,635 tons, which is less by 4,594,631 tons than for the same period of 1930, when the total was 16,478,266 tons. Exports of coal and coke alone from January 1st to June 7th last were 9,247,348 tons, whereas for the same period of 1930 the quantity was 12,983,356 tons.

Tin-plate Trade.

Reference has been made to the fact that the scheme for the regulation of production and prices in the tin-plate trade has come to an end, but it is reported that discussions took place last week in London with regard to resuscitating the scheme. These discussions were, however, only of a very preliminary character, and although no official information was forthcoming, it is understood that doubts are held whether sufficient support would be forthcoming from the industry as a whole to enable the project to be revived.

North Wales Coal Audit.

A recent announcement shows that the audit of the North Wales coalfield for April revealed a deficit of £906, or 0·82d. per ton, compared with a credit balance in March of £2969, or 2·37d. per ton, and in February a credit balance of £8424, or 7·79d. per ton. During the three months ended April the proceeds per ton have declined from 13s. 3·39d. to 13s. 0·25d., while costs have increased from 12s. 7·60d. to 13s. 1·07d. The heaviest increase has been in wages, which in April averaged 9s. 2·54d. compared with 8s. 11·24d. in February. The average wage per man-shift worked has been practically unchanged at 8s. 3d., while the output in April per man-shift worked was 17·94 cwt. against 18·48 cwt. in February. On the trading results for the three months ended April, the economic wage certified is only 4·97 per cent. above the basis rates, but the agreement provides for the payment of a minimum wage of 22 per cent. above the basis rates, and the deficiency accruing from this liability amounts to £61,231. The deficiency carried forward has therefore been further increased to £3,987,173.

Current Business.

Operations on the steam coal market provide no feature of any description, except that new business is slow to display any expansion and is wholly insufficient to meet the needs of most collieries. The position of various undertakings shows considerable irregularity. Comparatively few collieries are so well off for orders and ready tonnage that they can work uninterruptedly. The inquiry for large coals is uneven. Monmouthshires are fairly steady, but best Admiralty large coals do not meet with a very good demand. Dry coals move off moderately well, but sized qualities generally display irregularity, while smalls are very dull and stocks are as excessive as ever. There is no alteration so far as patent fuel and coke are concerned, and pitwood shows no improvement.

LAUNCHES AND TRIAL TRIPS.

GARTBRATTAN, single-screw steamer; built by Barclay, Curle and Co., Ltd., to the order of Gart Line, Ltd.; dimensions, 275ft. by 42ft. by 27ft. 6in.; to carry cargo. Engines, triple-expansion, 19in., 32in. and 54in. by 36in. stroke, pressure 200 lb. per square inch; constructed by the builders; trial trip, June 12th.

STEAM TUG No. 12; single-screw steam tug; built by Richard Dunston, Ltd., Thorne, near Doncaster; to the order of London and North-Eastern Railway Company; dimensions, 60ft. by 14ft. by 8ft. Engines, compound surface-condensing, 200 I.H.P.; trial trip, June 16th.

SIR RICHARD GRENVILLE, twin-screw steamer; built by Earle's Shipbuilding and Engineering Company, Ltd., to the order of Great Western Railway Company; dimensions, 180ft. by 42ft. 6in. by 15ft. 9in.; to carry passengers from liners at Plymouth. Engines, triple-expansion, 16½in., 27in., 46in. by 24in. stroke, pressure 185 lb. per square inch; launch, June 18th.

CATALOGUES.

FERRANTI, Ltd., Hollinwood, Lancs.—Moving coil instrument list M. 2.

COLEMAN AND CO., Aston, Birmingham.—A booklet on "Coleman" hot water specialities.

PALNUT COMPANY, Ltd., 26, Holborn-viaduct, E.C. 1.—Particulars of the firm's safety lock washers.

BERNARD HOLLAND AND CO., 17, Victoria-street, S.W. 1.—A combined technical data booklet and writing pad.

SAMUEL PEGG AND SON, Alexander-street, Leicester.—An 80-page catalogue of Pegson quarry and road plants.

STEATITE AND PORCELAIN PRODUCTS, Ltd., Stourport, Worcs.—A list of bushing insulators for all purposes and voltages.

A. L. CURTIS, P.O. Box 61, Westmoor Laboratory, Chatteris.—A brochure on high alumina blocks for lining rotary cement kilns.

H. TOLLEMACHE AND CO., Canada House, Norfolk-street, W.C. 2.—"The Application of Pulverised Fuel to Furnaces and Boilers."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16/-
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/3

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 10 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 6	3 2 6
No. 1	3 3 0	3 3 0
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(e) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(e) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(e) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 19 6 (*a*) / 4 1 6 (*b*) / 4 6 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	10 0 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0 to 7 15 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6	10 10 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 10 0 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	7 2 6	—
Soft Basic	6 0 0 to 6 5 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	5 0 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	9 17 6 to 10 5 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/6 to 13/9
Block Tin (cash)	108 17 6
„ (three months)	110 10 0
Copper (cash)	37 7 6
„ (three months)	38 1 3
Spanish Lead (cash)	12 17 6
„ „ (three months)	13 5 0
Spelter (cash)	12 7 6
„ (three months)	12 16 3
MANCHESTER—	
Copper, Best Selected Ingots	40 0 0
„ Electrolytic	41 10 0
„ Strong Sheets	67 0 0
„ Tubes (Basis Price), lb.	0 0 10
Brass Tubes (Basis Price), lb.	0 0 9
„ Condenser, lb.	0 0 11½
Lead, English	14 12 6
„ Foreign	13 5 0
Spelter	13 0 0
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c	£20 0 0	7/-
„ „ 8 p.c. to 10 p.c.	£20 0 0	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£31 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	10d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/-
„ „ Splint	14/6 to 16/-
„ „ Trebles	11/6 to 12/-
„ „ Doubles	11/-
„ „ Singles	10/-
AYRSHIRE—	
(f.o.b. Ports)—Steam	12/-
„ „ Jewel	17/-
„ „ Trebles	11/6
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/3 to 12/-
Screened Navigation	16/6 to 17/6
Trebles	11/6 to 13/-
Doubles	10/9 to 11/-
Singles	10/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/3 to 10/6
Trebles	12/-
Doubles	10/9 to 11/-
Singles	10/-

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		20/-
Household		30/- to 51/-
Coke		20/- to 20/6
NORTHUMBERLAND—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		7/6 to 8/-
Unscreened		12/6 to 13/-
Household		27/- to 39/-
DURHAM—		
Best Gas		14/6
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		24/-
SHEFFIELD—		
Best Hand-picked Branch	24/6 to 25/6	—
Derbyshire Best Bright House	19/- to 20/-	—
Best House Coal	18/6 to 20/-	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	14/6 to 15/-	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/6	—
Smalls	4/- to 5/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.	14/- to 15/-	

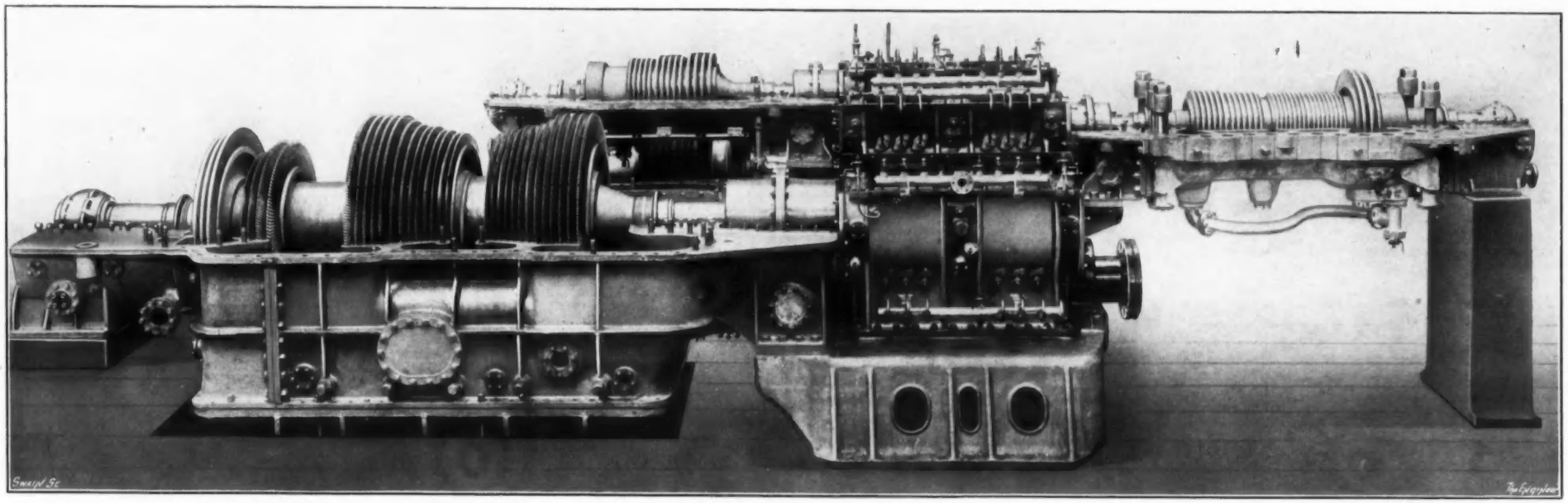
(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/3
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/9 to 18/-
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/- to 20/6
Pitwood (ex ship)	21/9 to 22/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 21/9
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

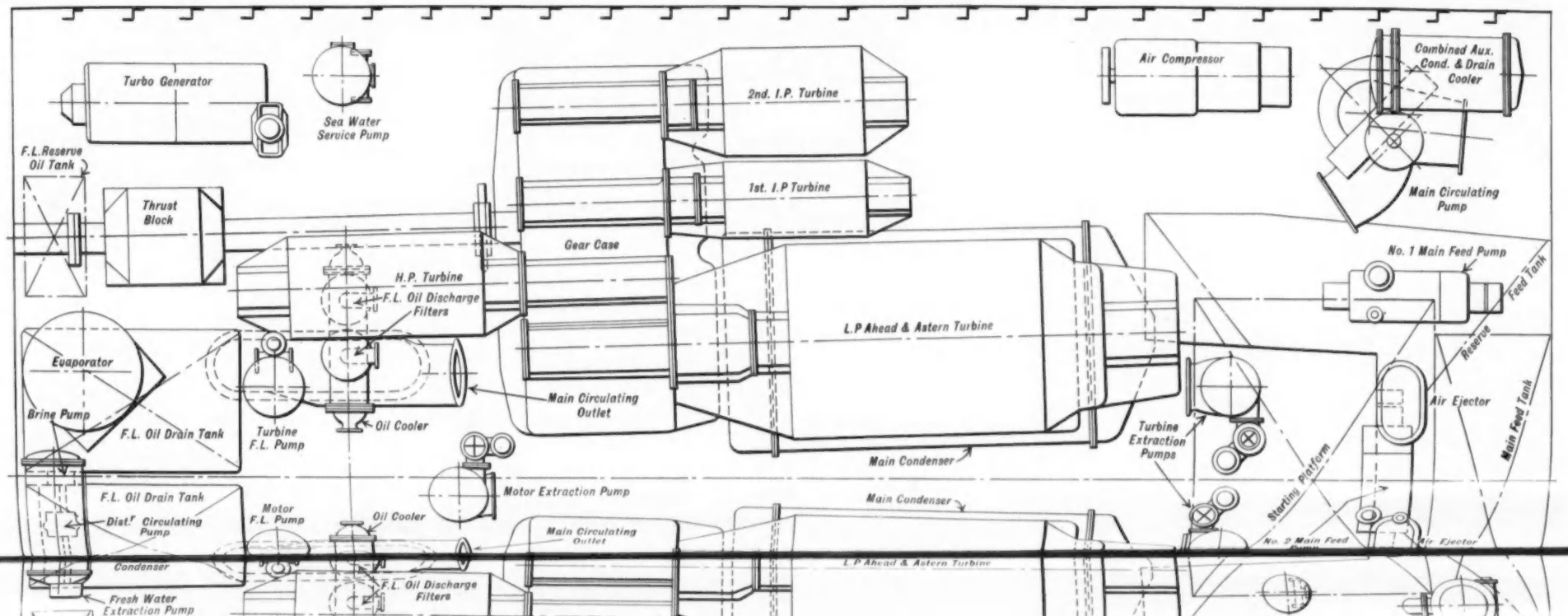
(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers.' (*e*) Delivered Black Country Stations.

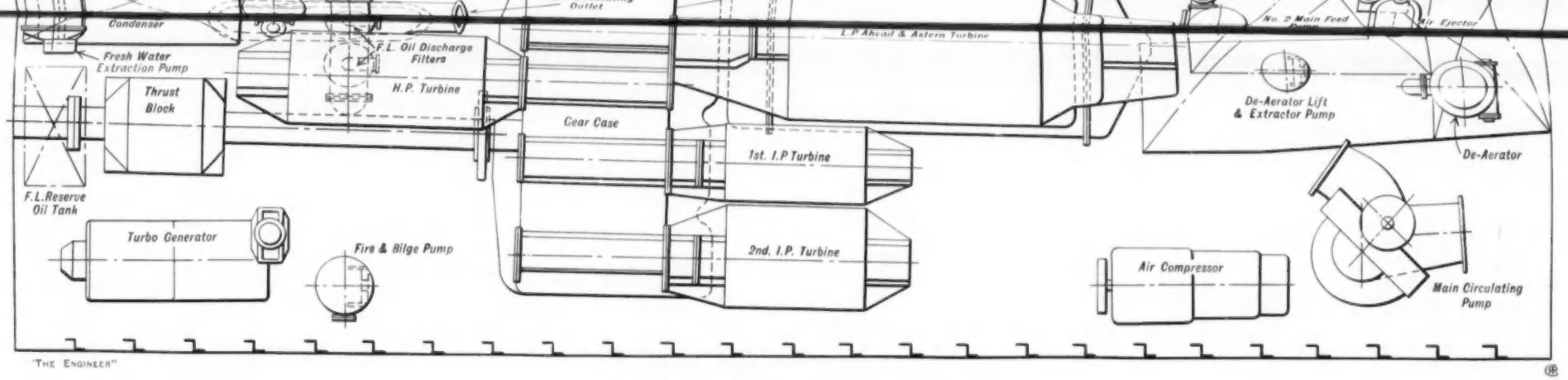
THE PROPELLING MACHINERY OF H.M. DESTROYER "ACHERON"

THE PARSONS MARINE STEAM TURBINE COMPANY, LTD., WALLSEND-ON-TYNE, CONTRACTORS



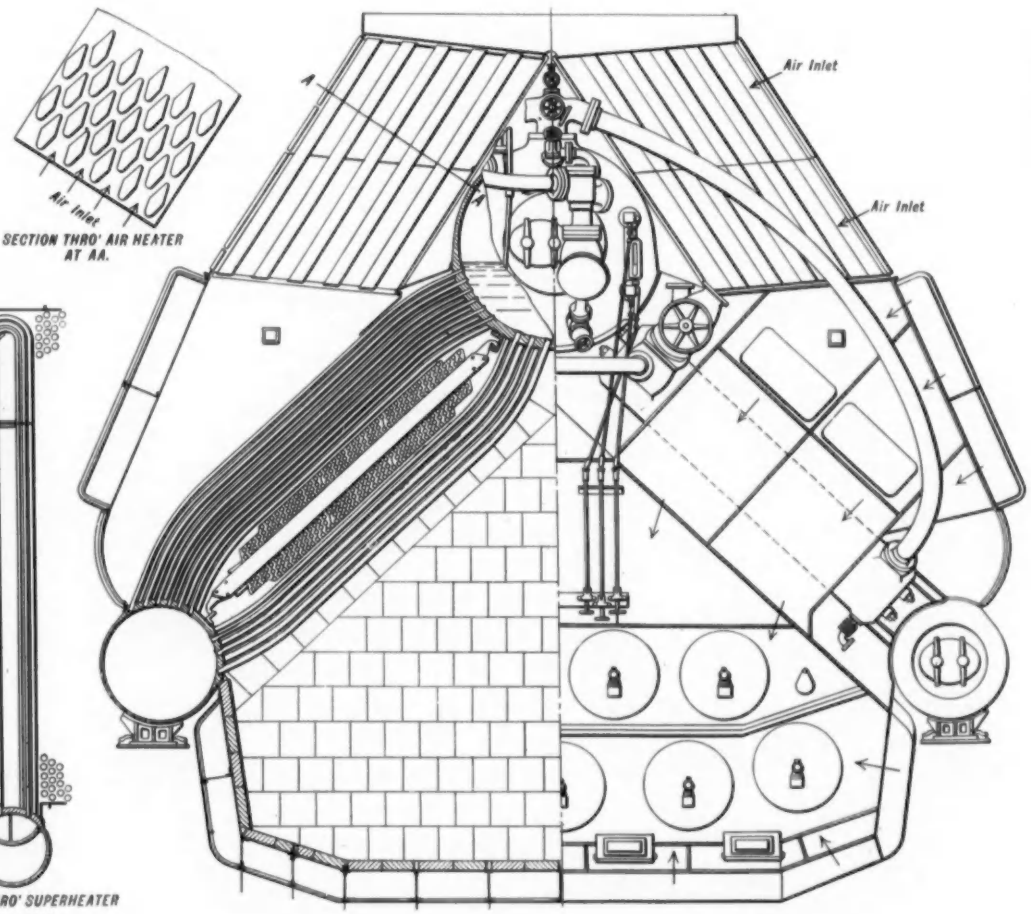
STARBOARD TURBINE UNIT





"THE ENGINEER"

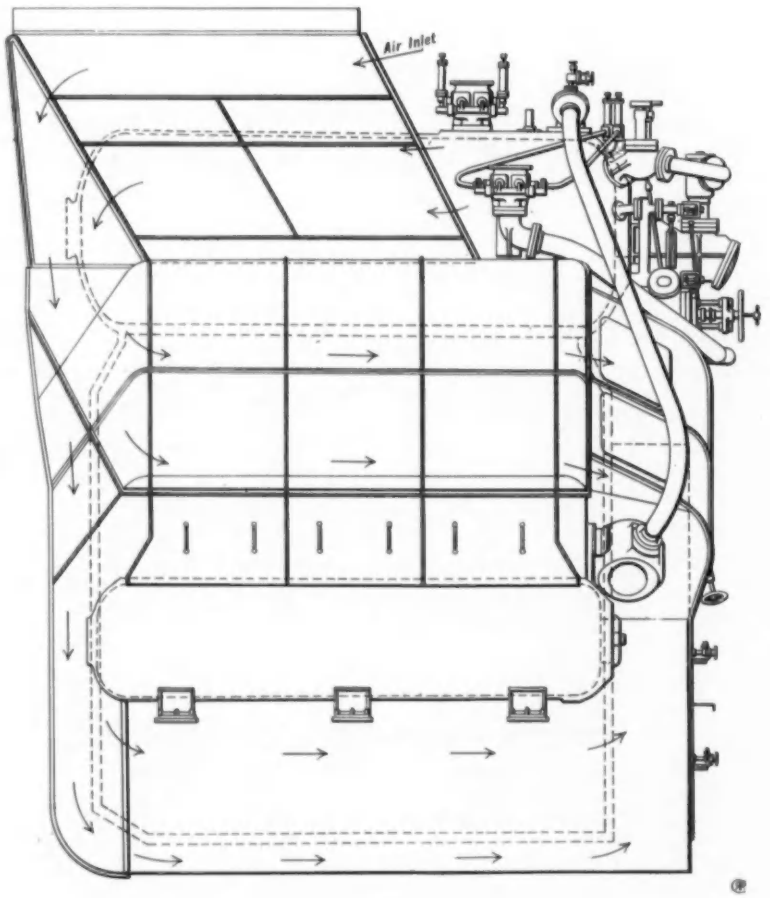
GENERAL ARRANGEMENT OF ENGINE ROOM



SECTION THRO' AIR HEATER AT AA.

SECTION THRO' SUPERHEATER

"THE ENGINEER"



HIGH-PRESSURE THORNYCROFT BOILER

French Engineering Notes.

(From our own Correspondent in Paris.)

The Trade Situation.

ALL feeling of optimism produced by the relatively more satisfactory position of France as compared with that of other countries is giving way before the increasingly unfavourable trade statistics, which are unrelieved by any encouraging feature except the smallness of the official unemployment returns. These returns do not take into account the partial elimination of foreign labour, and unemployment is certainly greater than is represented. The foreign trade returns during the first five months of the year show that the imports, amounting to 19,287 million francs, were 3384 million francs less than the total for the corresponding period of last year, and the exports, valued at 13,722 million francs, fell by 5528 million francs. The decline has been rapidly accelerating. As the situation calls for urgent remedies the Government has convened meetings of manufacturers and bankers with a view to settling upon a plan to finance enterprise in Austria and other Central European countries, under conditions that will benefit French manufacturers and to enter into agreements with foreign groups. A commission will be sent out for that purpose. Meanwhile the iron and steel production is falling, and so are prices, and the only hope for the immediate future lies in the operations of the Steel Cartel which the meeting at Budapest last week decided to prolong another month until the end of July in order to give more time to carry through the negotiations for its reconstitution on a new basis. The holding of the meeting at Budapest at the suggestion of steel makers in Central Europe suggests that the operations of the Cartel may be extended. The next meeting will take place in Paris, when it is hoped that the laborious negotiations will be brought to a successful issue. If not, the Cartel will probably be renewed from month to month until the matters under discussion are settled. The only redeeming feature of the international market is that Russia has at length come to terms with German mill and forge owners for the supply of 100,000 tons of bars, sheets and joists at the prices ruling nearly two months ago. The bars are to be supplied at £3 13s. 6d. to £3 14s. per ton, whereas the price on the international market is now £3 7s.

Naval Construction.

The new instalment of the programme of naval construction indicates a change in French ideas of naval strategy. They have been greatly modified since the programme was elaborated about eleven years ago. The results obtained in Germany in the designing and building of exceptionally powerful and fast ships within the 10,000-ton limit imposed by the Treaty of Versailles have caused much disquiet in this country. It is proposed to counter the German move by utilising the 70,000 tons allotted to France for battleships by the Washington Convention. The Chamber of Deputies was asked last week to sanction the new instalment which provides for the construction of the first of three battleships of 23,333 tons. The Minister of Marine insisted upon the urgency of this construction, and as the failure of the late negotiations in London relieved the French of any restriction as to gun calibre, they propose, it is said, to arm the new vessels with guns of 330 mm. or 340 mm. Nothing, however, has yet been definitely settled except that the maximum will be obtained in the way of speed, weight of projectiles and range of action. The Chamber was not satisfied with the Government's battleship policy, for if its object is merely to build a more powerful type of ship than the new German cruisers, there is no necessity to exceed twice the displacement, and if France settles upon a battleship of 23,000 tons some other countries may be tempted to outclass it with the maximum of 35,000 tons. Therefore the Chamber refused the credits for the battleship and requires the Ministry of Marine to revise its plans and see if the naval requirements cannot be met by ships of smaller tonnage. When that is done the Government can again ask Parliament for credits. This decision means that no work on battleships is likely to be undertaken before the disarmament conference early next year. Another change in French ideas is indicated by the absence of submarines from the new instalment. It is feared that the mastery of the submarine is threatened by the seaplane, and there is a growing impression that more should be done with seaplanes than with underwater craft, particularly in view of the fact that by the end of 1936 the country will have 86,000 tons of submarines. The total fixed by the Naval Statute is 96,000 tons. The construction of the other ships provided for in the programme will follow its normal course. These ships comprise two cruisers of 7500 tons, a sloop, a transport and four scouts.

Vegetable Oils.

The conference on vegetable oils at the International Colonial Exhibition did not advance materially the problem of their industrial utilisation, except to show that the Colonies can provide, in case of necessity, all that is required in the way of fuel for internal combustion engines as well as of lubricants. Otherwise, the cost is above that of mineral oils, which are more satisfactory. The oleaginous products of palm nuts, ground nuts, cotton seed and the like can be used in solid injection engines, but builders of such engines warn users that there must be a standardisation of fuels, without which the results may be disappointing. Whether vegetable oils can be produced cheaply enough to be employed as engine fuels is another matter. At present gas oil is supplied in the African Colonies at below the cost of local vegetable oils. It is a question whether the heavy production of colonial oils will not oblige producers to cheapen them for engine fuels by less refining and other means. That aspect of the question is only beginning to receive attention. The employment of vegetable oils as lubricants appears doubtful in view of their acid character, and even after the acid has been removed by chemical reaction it re-appears when the oil is exposed to moisture and air. A demonstration of lorries using different kinds of vegetable oils as fuel was made between Paris and Fontainebleau. It is believed that considerable progress will be made with the solid injection engine for industrial vehicles.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

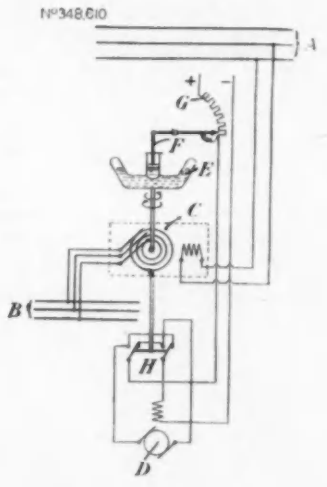
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

348,610. November 5th, 1929.—SYNCHRONISING A.C. GENERATORS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

In this specification a scheme is described for synchronising A.C. generators with an existing network by means of a doubly fed motor acting as a synchronoscope. A is the A.C. network, B the network to be connected in parallel, and C the synchronoscope. The rotor of the synchronoscope is fed from three phases of the network B and the stator from one phase of the network A. The speed governor of the engine driving the generator which is not shown, is adjusted by the motor D. On the rotor shaft of the synchronoscope C there is a centrifugal liquid-operated switch E, with a floating contact lever F, which controls a resistance G in the exciter circuit of the adjusting motor D. A



reversing switch H for reversing the circuits of the adjusting motor is provided for influencing the direction of rotation of the adjusting motor. On deviations in the frequency of the two networks A and B, the rotor of the synchronoscope will perform a rotary motion in one direction or the other, and vary the resistance G in the exciter circuit of the adjusting motor, and at the same time actuate the reversing switch H. The adjusting motor D is thus excited differently in one sense or the other, the speed governor being thereby adjusted in dependence on the frequency variations. In the case of great frequency difference the resistance G is short circuited. A slip coupling may be interposed between the switch for reversing the direction of rotation and the rotor shaft of the synchronoscope.—*May 5th*, 1931.

AERONAUTICS.

348,924. June 16th, 1930.—SUPPORTING PLANES FOR AIRCRAFT, J. F. Ziegler, Schwarzenbergplatz 2, Vienna 1, Austria.

This invention relates to the supporting planes for aircraft in which the channels are in the shape of longitudinal slits terminating at the bottom side in steps which act in the manner of nozzles. The essential feature of the invention consists in that the rear wall of the top end of the slits is super-elevated with respect to the rounded-off forward wall and is shaped to catch the onrushing air, so that, not only the sucking effect of the onrushing air at the bottom side of the plane is increased, but also the air striking the rear wall is forced to enter into the top end of the slits already in a compressed condition, where it finds a vacuum through which the air quickly passes into the

No348,924 Fig.1.

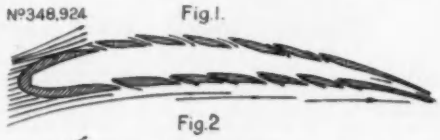
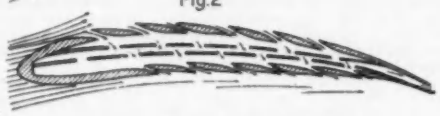


Fig.2



range of action of the sucking nozzle-shaped slits, and from there the air passes to the bottom side of the plane and additionally compresses the supporting air. In order to prevent an unfavourable action upon the bottom suction in case of a steeper incline of the supporting planes and of the greater vacuum which is thereby effected above the supporting plane, the latter is shaped hollow and, if desired, a compensating zone for paralysing the sucking effects at both sides is provided in the same by dividing its interior into three compartments with alternately disposed holes in the partitions thereof. Two modes of carrying out the invention are illustrated, in which Fig. 1 shows a simple hollow aircraft plane in section, and Fig. 2 illustrates a plane divided into a number of compartments.—*May 21st*, 1931.

TRANSMISSION OF POWER.

348,942. July 3rd, 1930.—ELECTRIC INSULATOR CHAIN, Brown, Boveri et Cie., A.G., of Mannheim, O 4 No. 8-9, Germany.

The invention relates to electric insulator chains for high-voltage live wires, especially those which pass through localities in which the air is contaminated. A are separate insulators of large diameter, and B insulators of smaller diameter, arranged as shown. In the interior of the insulators of both types there are

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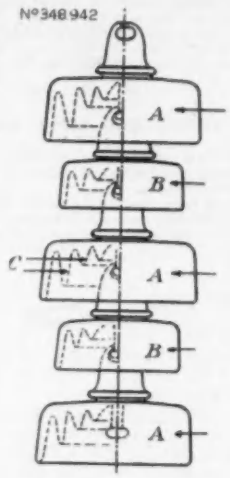

annular ribs C of different heights, by which the inner creeping path is substantially increased.—*May 21st*, 1931.

348,989. September 18th, 1930.—DAMPING THE OSCILLATIONS OF OVERHEAD LINES, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

According to this invention, a device for damping the cable oscillations comprises a container and a piston suspended from the line, one being connected directly to the line and the other adapted to oscillate, so that movements of both parts with respect to each other produce a damping friction of the air in the container. The overhead line is indicated by A. B is the air container suspended therefrom, and C the piston movable in the container. The piston is journalled upon a guide rod D, and connected to the housing by means of a helical spring E. A spring may also be arranged on each side of the piston. The guide rod D is fastened to the bottom of the container B, and to the sealed lid F. Its upper end is suspended from the overhead line by means of a universal joint G and a clip H. The disc-

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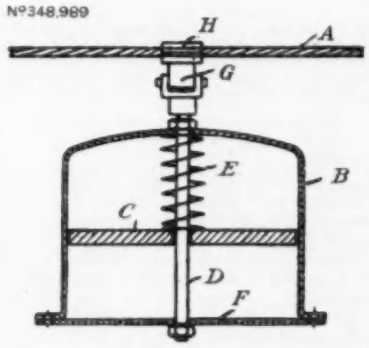

shaped piston C forms the heavy body, which, in conjunction with the spring E, represents a body capable of oscillation. The piston C is loosely mounted within the housing B, which must be light or provided with holes so that upon the movement of the piston the air can come in contact with the other side of the piston and dampen the movement. The device is suspended from the line at the distance of a few feet from the supporting clip. Should oscillations of the cable occur, then the damper will also oscillate with it. At the same time the heavy body C has the tendency to lag behind the oscillations of the housing B. In this way it is caused to oscillate. The spring mechanism, mass and air friction are so calculated that the oscillations of the device act in opposition to the oscillations of the cable and dampen them. At the same time a part of the oscillation energy is converted into heat by the friction of the air and destroyed.—*May 21st*, 1931.

PUMPING AND BLOWING MACHINERY.

348,920. June 13th, 1930.—A HYDRAULICALLY DRIVEN ROTARY PUMP, Société Anonyme Birotor, 161, Rue Saint Honoré, Paris, France.

It appears that the object of this invention is to raise water to

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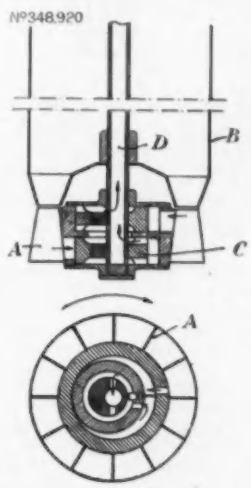


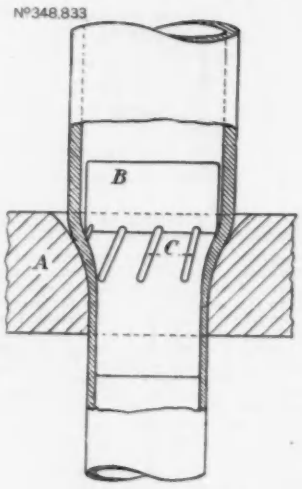
a considerable height by means of the power developed by water of a low head. The machine is described in the specification as being a "Hydraulically driven rotary pump characterised in

that a hydraulic turbine of any type of low pressure is combined with a rotary pump of the positive displacement type and of higher pressure in such a manner that the hub of the one—hydraulic turbine or pump—forms the body of the other—pump body or turbine casing—according to the case considered, the shaft in both cases serving as exhaust tube." The blades of the turbine are shown at A and it is to be presumed that the flow of water is downwards through the tube B. The rotary pump is indicated at C and discharges up through the central shaft D.—*May 21st*, 1931.

MACHINE TOOLS AND SHOP APPLIANCES.

348,833. April 11th, 1930.—THE MANUFACTURE OF SOLID-DRAWN TUBES, Société Marcel Bassot et Cie., 14, Rue de Turenne, Paris, France.

In this process of tube drawing the tube is drawn through the plate A, while its internal diameter is regulated by the mandrel B. The novelty of the arrangement lies in the fact that the

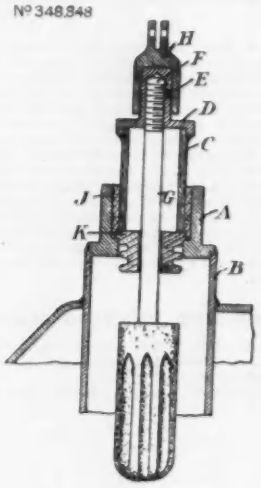


mandrel is grooved helically, as shown at C. The metal of the tube bites into these grooves and makes the mandrel rotate, which, it is said, tends towards a better finish of the tube than if the mandrel remains stationary. There is no comment in the specification as to the local effect of passing through the grooves on the qualities of the metal of the tube.—*May 21st*, 1931.

MISCELLANEOUS.

348,848. April 22nd, 1930.—GAS-TIGHT SEALS FOR ELECTRIC CONDUCTORS, *The British Thomson-Houston Company, Limited, of Crown House, Aldwych, London, W.C. 2.*

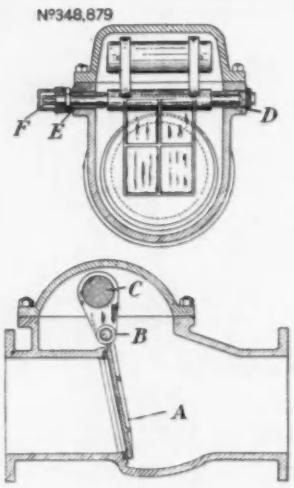
One object of this invention is to produce a new and improved vacuum-tight seal for high-current apparatus, such as mercury arc rectifiers, hot cathode rectifiers, metal thyratrons, &c. Another object is to construct a glass seal in such manner that the danger of breaking of the glass owing to uneven heating



and expansion is minimised. A is the outer portion of the improved seal, which may be formed integral with or suitably connected as by welding to the casing or wall B attached to or forming part of a high-current apparatus, for example, a rectifier, C designating the inner concentric member. The outer member is formed of a metal having a coefficient of expansion greater than that of the glass used, such as machine steel, and is copper coated on the inside, so as to present a surface which is "wetted" by glass when hot. The inner member C is shown as having a cap of machine steel D welded to the inner sleeve member C, and having a boss E integral therewith, which may be screw-threaded to receive the threaded end F of the electrode stem G. The attaching clip or connector H, made of a good conducting material, such as copper, is welded to the boss E. The inner member C is preferably formed of 26 per cent. chrome iron. The glass constituting the seal J is cast between the two concentric members A and C. K designates a piece of fired soapstone, which acts as a spacer and insulator between the outer and inner concentric members A and C, and between the conductor G, such as the anode stem in a rectifier, and the side wall of the inner sleeve member C. The inner sleeve member C is in the form of a relatively thin hollow cylinder. It will be seen that since the conducting member G is attached to the cap D, a relatively small portion of the inner member of the sleeve will heat up, as the heat transferred to the surface of the cap will be largely dissipated and only a small fraction will reach the side wall of the sleeve member C to heat the glass seal. As the heat has a tortuous path to travel in order to reach the surface of the glass, the liability of breaking of the glass seal owing to overheating by the large currents passing through the conductor is minimised, if not entirely eliminated.—*May 21st*, 1931.

348,879. December 4th, 1931.—NON-RETURN VALVES, Alley and Maclellan, Ltd., Sentinel Valve Works, Worcester, and J. O. Dick, 60, Battenhall-road, Worcester.

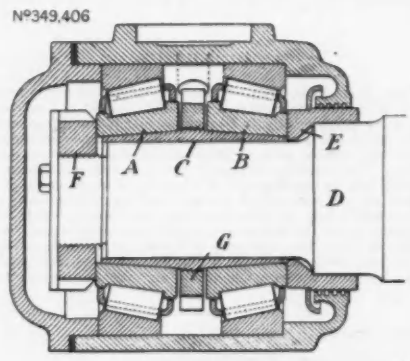
This flap valve is intended to be very free in its action, so that it will respond to small differences in pressure. The valve A is



pivoted on the spindle B and is counterbalanced by the weight C, which is described as a "machined cylindrical steel or other bar." The spindle works in bushings D E, of which E has a removable cap, so that access is obtainable to the squared end F for testing the freedom of the valve.—*May 21st*, 1931.

349,406. September 22nd, 1930.—ROLLER BEARINGS, British Timken, Ltd., Cheston-road, Aston, Birmingham, and P. C. Austin, 40, Tetley-road, Hall Green, Birmingham.

The object of this invention is to facilitate the removal of taper roller bearings from their axles. The inner races of the bearing are shown at A and B, and are mounted on the split sleeve C on the axle D. The race B butts against the ring E,



fixed on the axle, while A can be clamped up by the nut F. By tightening this nut the whole assembly is made secure on account of the tapered seatings of the inner races. Between the races there is a screwed ring G, which can be used to dislodge them from the sleeve, either by holding it and rotating the axle, or by holding the axle and rotating the ring with the axle box. For this purpose notches are provided in the periphery of the ring.—*May 28th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

MONDAY TO SATURDAY, JUNE 29TH TO JULY 4TH.

INSTITUTION OF NAVAL ARCHITECTS.—Paris summer meeting. For programme see page 514.

SECOND INTERNATIONAL CONGRESS OF THE HISTORY OF SCIENCE AND TECHNOLOGY.—For programme see page 524.

WEDNESDAY, JULY 1ST.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Joint visit with Newcastle and District Association to the main line widenings at Northallerton, on the London and North-Eastern Railway. Meet at Northallerton Station at 2 p.m.

TUESDAY TO SATURDAY, JULY 7TH TO 11TH.

ROYAL AGRICULTURAL SOCIETY OF ENGLAND.—Warwick Show.

WEDNESDAY TO FRIDAY, JULY 8TH TO 10TH.

INSTITUTION OF MINING ENGINEERS.—Ninety-third general meeting at Manchester. For programme see page 690.

THURSDAY, JULY 9TH.

BRITISH ELECTRO-FARMING CONFERENCE.—In the Members' Large Tent, Royal Agricultural Show, Warwick. Sixth Conference. "Electricity on the Farm, including Dairy and Poultry Farming," by Mr. M. M. Harvey. 3 p.m.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

SOCIETY OF CHEMICAL INDUSTRY.—Jubilee Celebrations. For provisional programme see page 471.

SUNDAY TO FRIDAY, SEPTEMBER 13TH TO 18TH.

INSTITUTE OF METALS.—Autumn meeting at Zürich.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. F. C. YAPP has been appointed a member of the board of Vickers-Armstrong, Ltd., as from June 18th, 1931.

MR. A. G. H. DENT was again elected chairman for the 1931–32 season of the Business Research and Management Association of Great Britain at the annual general meeting held on June 18th.

JOHN BENNIE, Ltd., of Glasgow, asks us to announce that the working arrangement between it and Marryat and Scott has now been terminated by mutual consent, and as a result Mr. Howard Marryat and Mr. Murray D. Scott automatically retire from the board.

ASSOCIATED EQUIPMENT COMPANY, Ltd., of Southall, has appointed new overseas distributors for its vehicles in New Zealand and Denmark. In the case of New Zealand, representation is now carried out by Messrs. Cory-Wright and Salmon, Dominion Farmers' Institute, Featherston-street, Wellington—G.P.O. Box No. 1230—with a branch at Gane Building, Anzac-avenue, Auckland—G.P.O. Box 1650—and in the case of Denmark by Messrs. Sven Caning, 19, Montergade, Copenhagen.

CONTRACTS.

SIEMENS BROTHERS AND CO., Ltd., have received an order from the Post Office for a further 200,000 "Neophone" instruments.

ELECTRIC FURNACE COMPANY, Ltd., of 17, Victoria-street, S.W. 1, has received an order from a continental steel works for a high-frequency furnace installation which will be the largest unit hitherto constructed. The motor generator set will have a power input of 1375 kW, and the furnace will be capable of melting 4-ton charges. Provision will also be made for a furnace body of 7 tons for the treatment of molten metal.

SIMON-CARVES, Ltd., Cheadle Heath, near Stockport, have secured orders for British "Baum" coal washeries from Bestwood Coal and Iron Company, Ltd., and the Cowpen Coal Company, Ltd., Newcastle-on-Tyne. The capacities of these washeries are 100 tons and 160 tons per hour respectively. In addition, orders have been secured for the extension of the washery belonging to the Manvers Main Collieries, Ltd., and for a Simon-Carves patent slurry plant for the existing "Baum" washer belonging to Emlyn Anthracite Colliery, Ltd., Swansea.

WE are informed that Dean, Smith and Grace, Ltd., have installed in their works at Keighley one of the latest combined nickel and chromium-plating plants. All parts, such as levers, hand wheels, knobs, &c., are first nickel and then chrome-plated. The firm believes that it is the first amongst the machine tool makers in the world to introduce this process on machine tools.

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